بِسۡمِ اللّٰهِ الرَّحۡمٰنِ الرَّحِيۡمِ

IN THE NAME OF ALLAH, THE ALL-MERCIFUL, THE ALL-COMPASSIONATE

Health Sciences

9

PUNJAB CURRICULUM AND TEXTBOOK BOARD, LAHORE

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Chapter 1

INTRODUCTION TO HEALTH SCIENCES

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Define health and illness based on WHO standards.
- Differentiate between physical, mental, and social well-being.
- Define communicable and non-communicable diseases.
- Identify common infectious diseases (e.g., tuberculosis, dengue, hepatitis) and their causes.
- List lifestyle-related non-communicable diseases (e.g., diabetes, heart disease, cancer).
- Describe the healthcare system in Punjab, including primary, secondary, and tertiary care levels.
- Identify government organizations involved in healthcare services.
- Explain the role of Basic Health Units (BHUs), Rural Health Centres (RHCs), and teaching hospitals.
- Identify key health indicators (infant mortality rate, maternal mortality rate, life expectancy).
- List various career options in health sciences.
- Describe the educational pathways required for different healthcare professions.
- Explain the objectives and impact of Government initiatives/programs on disease prevention and health promotion (e.g., Sehat Sahulat Program and vaccination campaigns).
- Analyse the impact of poor health on individuals, families, and society.
- Compare the socioeconomic burden of communicable vs. non-communicable diseases.
- Design an awareness campaign on disease prevention and control for the community.
- Interpret disease prevalence rates in Punjab.
- Analyse trends in Punjab's health statistics over the last decade.

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Health sciences is a multidisciplinary field that focuses on understanding human health, disease prevention, and healthcare systems. In this subject, we will get knowledge about the basic medical concepts and will also know public health strategies to improve individual and community well-being. In this chapter, we will explore key concepts related to health and illness. We will also learn about the healthcare structure in Punjab and will explore various career opportunities in health sciences.

1.1 HEALTH AND ILLNESS

Health

According to the World Health Organization (WHO), "health is a state of complete physical, mental, and social well-being and not merely the absence of disease or illness". It means that a healthy person is the one who has these characteristics:

- He is free from illness.
- He has the ability to perform daily activities efficiently.
- He maintains emotional balance.
- He interacts positively with others.

Good health depends on many factors e.g., balanced diet, regular exercise, clean environment, and access to healthcare services (e.g., clinics, hospitals) etc.

Key Aspects of Health

Health is a combination of different aspects. These aspects are interconnected and essential for a healthy life.

1. **Physical Well-being:** It means the proper functioning of the body and its systems. A person with good physical health has energy for daily activities, a strong immune system, and no major illnesses. Physical well-being depends on balanced diet, regular exercise, proper rest, and avoiding harmful substances.
2. **Mental Well-being:** Mental well-being involves emotional stability, clear thinking, and the ability to handle stress. A person with good mental well-being can manage emotions, cope with challenges, and maintain self-confidence. Conditions like anxiety and depression can affect mental well-being.

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3. Social Well-being: This aspect focuses on a person's ability to interact positively with others and maintain healthy relationships. Social well-being is achieved through strong family bonds, friendships, teamwork, and community support.

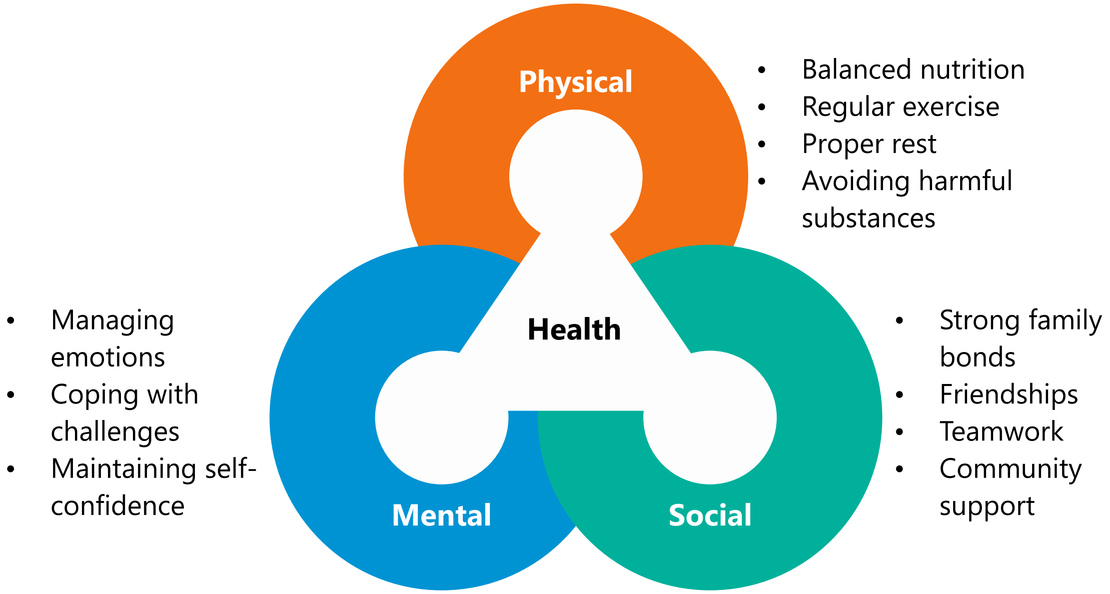

FIGURE 1.1: Key aspects of health

Illness

Illness is a condition in which a disease or other health-related issue disturbs the normal functioning of the body or mind. "Illness" is a broader term that describes a person's experience of feeling unwell due to disease, disorder, or other health issues. Illness can be short-term (acute) or long-term (chronic).

Disease and Disorder: A disease is a specific condition that affects the normal functioning of the body or mind. It may be caused by infections, genetic factors, or environmental influences. It usually has clear signs and symptoms, such as fever in malaria or high blood sugar in diabetes. Disorder means an abnormal condition that disrupts normal body structure or function but may not always have a clear cause or specific symptoms. For example, neurological disorders like epilepsy or mental health disorders like anxiety.

Impact of Illness

Illness affects individuals, families, and society as a whole. When a person is ill, he faces difficulty to perform daily tasks, experiences emotional suffering, and

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requires medical treatment. The family of an ill person faces financial burdens due to medical expenses. It limits family's overall well-being. At the society level, widespread illness reduces productivity, increases healthcare costs, and puts pressure on medical facilities.

1.2 TYPES OF DISEASES

Diseases can be classified into two main types: communicable and non-communicable diseases.

Communicable Diseases

These are the illnesses caused by infectious agents such as bacteria, viruses, fungi, or parasites. These diseases can spread from person to person or from the environment to person. Communicable diseases can be classified on the basis of the causative organisms. These are as follow:

1. Bacterial: Typhoid, cholera, tuberculosis
2. Viral: Common cold, influenza, HIV infection, hepatitis, dengue
3. Protozoal: Malaria, kala azar
4. Fungal: Fungal infections of nails, groins, skin, hair
5. Parasitic: Infestations of intestinal worms (e.g., round-worm), or lice

> Communicable diseases can be prevented through hygiene and vaccinations.
>
> Non-communicable diseases require long-term management and healthy lifestyle choices.

Treatment of Communicable Diseases

1. **Viral infections:** Vaccines are an effective method for preventing specific viral infections. When a person receives a vaccine, his immune system produces antibodies that kill the active form of virus. If a person has got a viral infection, he may require antiviral medicines.

2. **Bacterial infections** require a course of antibiotics to help control the infection. Antibiotics can kill bacteria or slow their growth.

> Overuse of antibiotics by people has caused resistance in many bacteria. It is a major health risk.

3. **Fungal infections** require antifungal medications.
4. **Protozoal and parasitic diseases** require different anti-parasitic medicines.

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Non-Communicable Diseases

Non-communicable diseases (NCDs) are not caused by infections and cannot spread from person to person. They usually develop due to genetic factors, unhealthy lifestyles, or environmental factors. Most NCDs are chronic and last for a longer period of time.

There are three major categories of non-communicable diseases.

1. **Lifestyle Related Diseases:** These diseases develop due to unhealthy lifestyle. These include heart diseases, hypertension, diabetes, cancer, and stroke. Mental health diseases like trauma and depression are also included in this category.
2. **Genetic Diseases:** Genetic diseases are caused due to abnormalities in genes or chromosomes. These errors can be either inherited or caused by mutations. Examples include haemophilia, thalassemia, and muscular dystrophy.
3. **Degenerative Diseases:** These diseases result from the gradual decline of body organs or tissues due to aging or other factors. Examples include Alzheimer's disease, Parkinson's disease, and arthritis.

According to WHO:

1. NCDs are responsible for about 75% of non-pandemic-related deaths in the world.
2. Of all NCD deaths, 73% are in low- and middle-income countries.
3. Heart diseases account for most NCD deaths, followed by cancers, chronic respiratory diseases, and diabetes.

1.3 HEALTHCARE SYSTEM IN PUNJAB

Health sector of Punjab has a vast network of public and private health institutions throughout the province. The healthcare system of Punjab is divided into three levels i.e., primary, secondary, and tertiary care. Primary and secondary healthcare are administered by the Primary and Secondary Healthcare Department of the Government of Punjab. While tertiary Healthcare is administered by the Specialized Healthcare & Medical Education Department of the Government of Punjab.

1. Primary Healthcare

Primary healthcare is the first level of medical assistance for citizens. It provides basic health services such as vaccinations, maternal and child healthcare, and treatment of common illnesses. Two types of health centres provide primary healthcare.

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Basic Health Units (BHUs): These are situated at the Union Council level. In Punjab, there are more than 2,530 BHUs in the rural and semi-urban areas. Each BHU has 2 beds. BHUs offer basic medical services, maternal and child healthcare, immunizations.

Rural Health Centres (RHCs): These are located at the village level. There are about 375 RHCs in Punjab. Each RHC has 15 to 20 inpatient beds, dental services, and ambulance facilities. RHCs provide more advanced healthcare than BHUs.

> There are about 1185 Govt. dispensaries in Punjab. A dispensary is an institution which has less than 10 beds.

Maternal and Child Health Centres (MCHs): These facilities provide maternal, neonatal and child health services including reproductive health and family planning. MCHs are located in urban and large rural areas. They are managed by Lady Health Visitors and assisted by traditional birth attendants. In Punjab, there are 275 MCHs.

> There are 37 special Tuberculosis Centres in Punjab.

2. Secondary Healthcare

Secondary healthcare provides more specialized medical services than primary care. This level includes:

Tehsil Headquarters (THQ) Hospitals: These are situated at the tehsil level. There are about 132 THQ hospitals in Punjab. They receive the patients referred by BHUs and RHCs. Each THQ hospital has about 40-60 inpatients beds. They have departments like surgery, orthopaedics, cardiology, gynaecology/obstetrics, and paediatrics. They also provide support services like blood banks and emergency and trauma centres.

District Headquarters (DHQ) Hospitals: These are located at the district level. There are about 36 DHQ hospitals in Punjab. A DHQ hospital has 125-250 beds. They receive patients referred from THQ hospitals, RHCs, and BHUs. These hospitals have trained professionals such as specialists, surgeons, and laboratory technicians to handle more complex health conditions.

3. Tertiary Healthcare

Tertiary healthcare includes major hospitals and teaching hospitals. These hospitals provide healthcare services to patients, usually referred from a primary or secondary healthcare. In tertiary healthcare, advanced diagnostic and

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treatment facilities are provided. The major hospitals have full range of specialities like paediatrics, general medicine, surgery and psychiatry. Major hospitals also include specialty hospitals. These hospitals provide specific care (e.g., paediatric centres, oncology centres, psychiatric hospitals).

A trauma center is a hospital to provide care for patients suffering from major traumatic injuries such as falls, motor vehicle collisions, or gunshot wounds. There are 9 trauma centres in Punjab.

There are more than 874 major hospitals in Punjab out of which 250 are controlled by the health departments of Punjab. Similarly, 89 major hospitals are controlled by other government departments (Social Security Department, Pakistan Railways, WAPDA, Home Department etc.) and 535 are controlled by private organizations.

Teaching hospitals provide advanced medical services and serve as teaching institutes for healthcare professionals (e.g., doctors). These hospitals are located in major cities and divisional headquarters. There are 48 teaching hospitals in Punjab.

1.4 KEY HEALTH INDICATORS

The health status of a population is measured in terms of health indicators. The following are the three key health indicators:

1. Infant Mortality Rate (IMR)

It is the number of deaths of infants (under one year of age) per 1,000 live births in a year. A high IMR often reflects inadequate healthcare, poor maternal health, or substandard living conditions.

2. Maternal Mortality Rate (MMR)

It is the number of women who die due to pregnancy-related complications per 100,000 live births in a year. This rate is a critical indicator of the quality of healthcare systems. High MMR indicates insufficient medical services, lack of skilled medical professionals, or socio-economic disparities.

In Pakistan,

The infant mortality rate (per 1,000 live births in 2022) is 51.

The Maternal Mortality Rate (per 100,000 live births in 2022) is 154.

3. Life Expectancy

Life expectancy is the average number of years a new born is expected to live. It

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reflects the overall mortality level of a population. Life expectancy is influenced by healthcare quality, lifestyle, and socio-economic conditions.

Pakistan Health Statistic

According to the world Health Organization (WHO), the latest health data comprises figures of different years. The following table summarizes this data.

Table: Selected Health Indicators of Pakistan

Health Indicator	Value
Tuberculosis cases /100,000 population (2023)	277
Malaria cases /1,000 population (2021)	2.2
Hepatitis B prevalence among children <5 years (2020)	0.9%
Probability of deaths from non-communicable diseases (2019)	29%
Under five mortality /1,000 live births (2022)	61
Mortality due to air pollution /100,000 population (2019)	195
Mortality due to unsafe WASH /100,000 population (2019)	39
Hypertension cases in 30 years and above (2019)	43%
Stunting <5 years (2022)	34%

Punjab Health Statistics

Punjab constitutes more than half the population of Pakistan. In spite of vast network of healthcare facilities, health status of the province is not good. According to the latest data, infant mortality rate in Punjab is 77 per 1000 live births. Under 5 mortality rate is 112 per 1000 live births. Maternal mortality ratio is about 157 per 100,000 live births.

Currently, there are about four million malnourished children in Punjab, and about a third of all pregnant women have iron deficiency anaemia. Over 34 percent of children under the age of five years are short for their age; over 10 percent are under weight for their age. Malnutrition is a major contributor to infant and maternal deaths.

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Table: Selected Health Indicators of Punjab	
Health Indicator	**Value**
Infant Mortality Rate /1,000 live births	77
Maternal Mortality Rate /100,000 live births	300
Under-five Mortality Rate /1,000 live births	112
% age of Under Nutrition(<5 years)	34
Life Expectancy at birth (in years)	64

Top 10 Diseases in Punjab

The following graphs show the comparison of top 10 diseases percentage of years 2015 to 2019. The data covers about 82 million patients who consulted healthcare institutions.

In Pakistan, for every 10,000 people we have:

- 10.8 Doctors
- 1.2 Dentists
- 4.7 Nurses
- 1.5 Pharmacists

(Source WHO data)

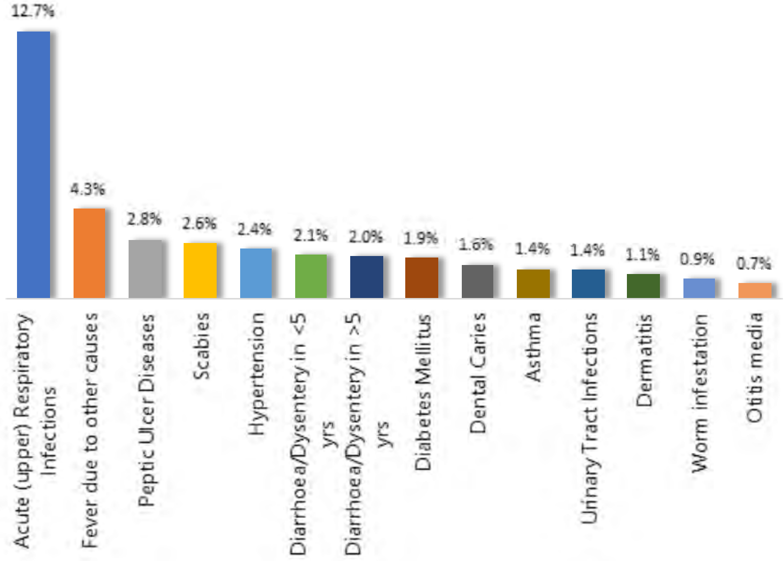

Figure 1.2: Top Ten Diseases (2015-2019)

Activity

- Compare the socioeconomic burden of communicable and non-communicable diseases.

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Major Communicable and Non-Communicable Diseases in Punjab

According to the data received by the health departments of Punjab, the following are the major communicable and non-communicable diseases reported in different healthcare institutions.

Table: Top 10 Communicable and Non-Communicable Diseases	
Communicable Diseases	**Non-Communicable Diseases**
1. Acute (Upper) Respiratory Infections	**1.** Fever due to other causes
2. Scabies	**2.** Peptic Ulcer Diseases
3. Diarrhoea / Dysentery <5 years	**3.** Hypertension
4. Diarrhoea / Dysentery >5 years	**4.** Diabetes Mellitus
5. Worm Infestations	**5.** Dental Caries
6. Suspected Viral Hepatitis	**6.** Asthma
7. Enteric / Typhoid Fever	**7.** Dermatitis
8. TB Suspects	**8.** Otitis Media
9. Suspected Malaria	**9.** Chronic Obstructive Pulmonary Diseases
10. Pneumonia <5 years	**10.** Heart Diseases

1.5 PUNJAB GOVERNMENT HEALTH INITIATIVES

The Punjab Government has implemented several initiatives aimed at disease prevention and health promotion to enhance the well-being of its residents. Two the following are the notable programs.

1. Sehat Sahulat Program

In this program, the Punjab Government offers free medical / surgical facilities through more than 350 major hospitals (150 private more than 200 government

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hospitals). The program's objective is to improve access of the population to good quality medical services. It has significantly reduced catastrophic health expenditures for low-income families, thereby narrowing the equity gap in healthcare accessibility.

Sehat Sahulat program provides two treatment packages for all citizens.

i- Priority Treatment

It provides initial coverage of Rs. 400,000 / family / Year. This package covers the treatment and management of:

1. Heart diseases
2. Diabetes complications
3. Burns, accident, trauma and emergency
4. Organ failure
5. Cancer
6. Autoimmune diseases
7. Blood disease / disorder
8. Chronic infections
9. Neurosurgery
10. Rheumatology / orthopaedic / musculoskeletal
11. Corrective procedures for disabled and artificial limbs placement
12. Renal transplant

ii- Secondary Care

This treatment package provides initial coverage of Rs. 60,000 / family / Year. This packages covers the treatment and management of:

1. Inpatient services (all medical and surgical procedures)
2. Emergency treatment requiring admission
3. Maternity services
4. Maternity consultancy / antenatal check-ups
5. Maternal consultancy for family planning, immunization and nutrition
6. Fractures / injuries
7. Post hospitalization treatment
8. Local transportation cost of Rs. 1,000 (thrice per year).
9. Provision of transport to tertiary care hospitals.

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2- Expanded Program on Immunization (EPI)

This is a program of Punjab government to protect children against diseases through vaccination. In this program, about 3.39 million children of 0-23 months are vaccinated annually against the following 12 dangerous diseases.

1.	Tuberculosis	2.	Poliomyelitis	3.	Diphtheria
4.	Pertussis	5.	Tetanus	6.	Measles
7.	Hepatitis B	8.	Meningitis	9.	Diarrhoea
10.	Typhoid	11.	Pneumonia	12.	Rubella

Immunization (vaccination) is carried out at fixed centres and outreach sites. EPI vaccination centres are located in all public health institutions and also in some private hospitals in Punjab. More than 4,000 vaccinators work as outreach worker at UC level.

3- Hepatitis Prevention and Control Program (HPCP)

HPCP is another program of the Punjab government that works for the prevention and control of hepatitis. In this program, the government provides free hepatitis B vaccine and hepatitis C & B testing and treatment. This program also provides hepatitis-related education and consultation. It has 281 Hepatitis Clinics at DHQ and THQ hospitals, teaching hospitals, and partner organizations for free services. The following are the main activities carried out in this program.

1. Introduction of Auto Disabled (AD) syringes
2. Monitoring of barbers & beauty salons
3. Mandatory screening of blood before blood transfusion
4. Implementation of waste management in all healthcare facilities
5. Mandatory testing before dialysis, surgeries and organ transplant
6. Compulsory hepatitis B vaccination of new-borns

4- TB Control Program

In TB control program, the government provides free TB diagnostic and treatment services in public and private healthcare institutions. There are 558 TB Basic Management Units (BMUs) and 558 Microscopy Labs across Punjab in primary, secondary and tertiary healthcare institutions. These units also provide

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TB Preventive Therapy to the contacts of TB positive patents. Free home delivery is done for the medicines to TB patients. This program also do TB screening through mobile X-Ray vans.

5- Punjab AIDS Control Program

The main purpose of the Punjab AIDS Control Program is to prevent HIV transmissions and improve the health and quality of life of people living with HIV/AIDS. In this program, the government provides free testing, treatment and consultation services to HIV/AIDS patients and at-risk people e.g., Injecting Drug Users (IDUs), and Sex Workers. The program has 45 AIDS control centres in government healthcare institutions across Punjab.

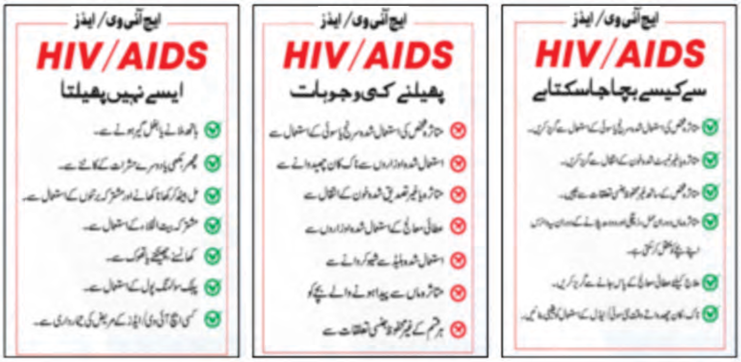

Figure 1.3: Educational Material Developed by Punjab AIDS Control Program

> **Activity**
> - Search the website for "Prevention and Control of Non-Communicable Diseases" Program of Punjab Government and design an awareness campaign on disease prevention and control for the community.

1.6 CAREERS IN HEALTH SCIENCES

The field of health sciences offers many career opportunities, each with specific educational pathways.

Career	Educational Pathway
Physician and Surgeon	Bachelor of Medicine and Bachelor of Surgery (MBBS)
Dentist	Bachelor of Dental Surgery (BDS)
Nurse	Bachelor of Study (BS) in Nursing

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Pharmacist	Doctor of Pharmacy (Pharm. D)
Physiotherapist	Doctor of Physiotherapy (DPT)
Medical Laboratory Technologist	Bachelor of Study (BS) in Medical Laboratory Technology
Health Information Manager, Clinical Data Analyst	Bachelor of Study (BS) in health informatics
Epidemiologist, Public Health Advisor, Health Educator	Master of Public Health (MPH)
Biomedical Researcher, Clinical Research Scientist	Bachelor of Study (BS) in biotechnology or a related field
Dispenser, Pharmacy Technician, Medical Store Operator	Diploma in Dispenser/Pharmacy Technician
Medical Imaging Technologist	Bachelor of Study (BS) in imaging technology

EXERCISE

A. Select the correct answers for the following questions.

1. A person feels weak, but medical tests are normal. This is:
   a) A disease b) A disorder
   c) An illness d) An infection
2. What is the best definition of "health"?
   a) No illness or disease.
   b) A fit and active body.
   c) Physical, mental, and social well-being.
   d) Ability to do daily tasks.
3. A person exercises but feels lonely. What is affected?
   a) Physical health b) Mental health
   c) Social health d) Emotional health

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4. Lack of clean water mostly can affect:
   a) Physical health b) Social health
   c) Mental health d) Emotional health

5. Which disease spreads from person to person?
   a) Diabetes b) Influenza
   c) Hypertension d) Cancer

6. Which statement is correct for non-communicable diseases?
   a) Cannot spread from person to person
   b) Caused by bacteria and viruses
   c) Treated with antibiotics
   d) Spread through air and water

7. Which of these is a communicable disease?
   a) Asthma b) Stroke
   c) Tuberculosis d) Arthritis

8. Which method best controls non-communicable diseases?
   a) Healthy lifestyle and early screening
   b) Taking antibiotics
   c) Wearing masks
   d) Avoiding public places

9. Which institutions provide primary healthcare in Punjab?
   a) District Headquarters (DHQ) hospitals
   b) Tehsil Headquarters (THQ) hospitals
   c) Basic Health Units (BHUs)
   d) Teaching Hospitals

10. Which healthcare institution is most suitable for heart surgery?
   a) Tehsil Headquarters (THQ) hospital
   b) Teaching hospital
   c) Rural Health Center (RHC)
   d) Basic Health Unit (BHU)

B. Write short answers.

1. Differentiate between illness, disease, and disorder with examples.
2. What are the three main dimensions of health? Describe each briefly.
3. Differentiate between communicable and non-communicable diseases.

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4. Briefly describe the functions of three levels of healthcare in Punjab?
5. Define Infant Mortality Rate (IMR) and Maternal Mortality Rate (MMR).

C. Write answers in detail.

1. Describe the three dimensions of health: physical, mental, and social well-being. How are they interrelated?
2. Classify non-communicable diseases with examples.
3. Explain the structure of the healthcare system in Punjab.
4. Compare Basic Health Units (BHUs), Rural Health Centres (RHCs), and Tehsil Headquarters (THQ) hospitals.
5. What are the functions of District Headquarters (DHQ) hospitals and Teaching hospitals?

Group Activities

1. Write a short essay on the importance of primary healthcare in Punjab.
2. Create a poster on the prevention and management of hepatitis in Punjab.
3. Write the challenges of managing cardiovascular diseases in Punjab.
4. Create a presentation on improving immunization coverage in Punjab.

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Chapter 2

GASTROINTESTINAL SYSTEM

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Describe the functions of each part of the GI system.
- Explain how the GI system interacts with other body systems to maintain homeostasis.
- Describe the causes, symptoms, and risk factors of GERD and peptic ulcers.
- Explain the impact of GI disorders on daily life and overall health.
- Identify the pathogens responsible for common GI infections (e.g., cholera, typhoid, gastroenteritis).
- Discuss the transmission, symptoms, and complications of GI infections (e.g., cholera, typhoid, gastroenteritis).
- Discuss the role of the GI system in nutrient absorption.
- Briefly describe common diagnostic procedures (e.g., endoscopy, imaging, blood tests).
- Identify the major organs of the GI system on diagrams or models.
- Relate the structure of GI organs to their specific functions.
- Interpret clinical symptoms to differentiate between GERD, and peptic ulcers.
- Suggest lifestyle and dietary modifications to manage these conditions.
- Recommend preventive measures (e.g., hygiene, vaccination) for GI infections.

The **gastrointestinal (GI) system**, also known as the **digestive system** consists of alimentary canal (the continuous tube running from the mouth to the anus) and accessory organs. It is responsible for breaking down food, absorbing nutrients, and eliminating waste. This chapter explores the function of the GI system, as well as common GI disorders, infectious diseases, inflammatory conditions, and diagnostic tests.

2.1 FUNCTIONS OF GASTROINTESTINAL SYSTEM

Alimentary canal

- Digestion begins in the **mouth**. Here, the food is broken down by

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chewing and by enzymes of the **saliva**. A **muscular tube** that connects the mouth to the stomach is called the **oesophagus**.

- The **stomach** is a **muscular organ** that churns food and mixes it with **gastric juice**. This juice contains **hydrochloric acid (HCl)** which kills bacteria, enzyme **pepsin** that breaks down proteins and mucus which protects the stomach wall from acid and enzyme damage.

> The stomach produces hydrochloric acid strong enough to dissolve some metals, yet it doesn't harm the stomach because of mucus lining.

- The partially digested food, now called **chyme,** moves into the **small intestine** for further digestion.
- The **small intestine** is a long, coiled tube that plays a crucial role in digestion and nutrient absorption. Digestive enzymes from the **pancreas** and **bile** from the **liver** enter in small intestine. They help break down carbohydrates, proteins, and fats.

> The small intestine is about 6 meters (20 feet) long, yet it fits inside the abdomen by coiling tightly.

- The inner walls of the small intestine have **tiny finger-like projections called villi.** Villi also have even small projections called **microvilli**. These structures **increase the surface area** for maximum absorption of nutrients.
- The walls of the small intestine have **muscles** that contract and relax in a wave-like motion, called **peristalsis**. This movement helps push food forward and mix it with digestive juices.
- After the digested products of food have been absorbed, the remaining mass enters **large intestine**. Here water is absorbed into blood. As water is absorbed, the solid remains of food are called faeces. Large intestine is responsible for the storage and controlled elimination of solid waste through the process of **defecation**.

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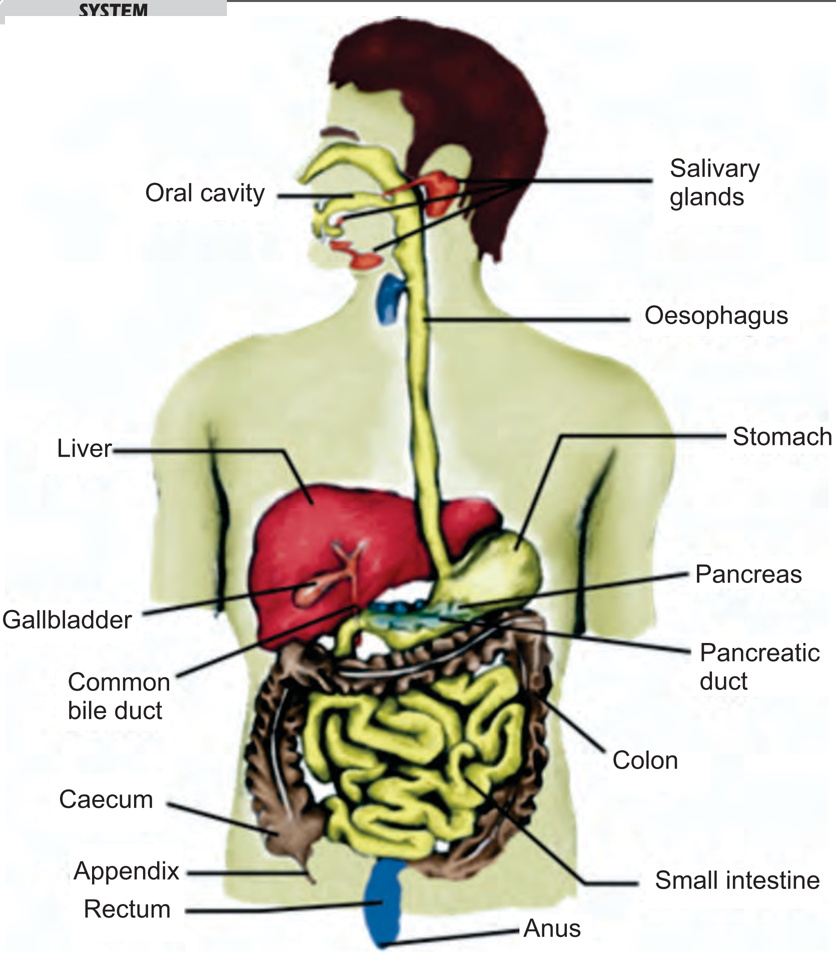

Figure 2.1: Gastrointestinal system

Accessory Organs

Liver

The **liver** is the largest organ in the human body. It is located in the upper right side of the abdomen. Liver plays a crucial role in digestion, metabolism, detoxification, and overall health.

It performs many functions some of which are given below:

- The liver produces bile, a yellow-green fluid that helps break down fats in the small intestine. Bile is stored in the gallbladder and released when needed to digest fatty foods.
- It stores glucose (sugar) in the form of glycogen and releases it when the body needs energy.

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- It helps in the metabolism of proteins and fats, making essential substances like cholesterol and amino acids.
- The liver removes toxins from the blood.
- The liver stores important nutrients such as vitamins (A, D, E, K, and B12), iron, copper, zinc, etc.

Gallbladder: Stores bile, which is released into the small intestine to facilitate lipid digestion.

Pancreas

Produces digestive enzymes, which facilitate the breakdown of proteins, carbohydrates, and fats.

2.2 INTERACTION OF GI SYSTEM WITH OTHER SYSTEMS

The **gastrointestinal (GI) system** plays a vital role in maintaining **homeostasis.** However, it does not function in isolation. Instead, it interacts with multiple body systems to regulate energy balance, fluid levels, and overall health.

1. Cardiovascular System

After digestion, nutrients (e.g., glucose, amino acids, fatty acids) are absorbed from the small intestine into the **bloodstream**. The absorbed nutrients are transported to cells throughout the body. The liver filters toxins from the blood and helps regulate blood sugar levels.

2. Muscular System

Smooth muscles in the GI tract enable the movement of food through peristalsis. It ensures proper digestion. The muscular system depends on nutrients like proteins and calcium from the digestive system for muscle repair and contraction.

3. Renal System (Kidneys)

The GI system works with the renal system to regulate fluid and electrolyte balance. For example, the GI system absorbs water from digested food, and the kidneys help filter and reabsorb water, maintaining hydration status.

4. Immune System

The GI tract, particularly the intestines, provide first line of defence against

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pathogens. Beneficial gut bacteria (microbiota) help prevent infections. Similarly, the stomach's acidic environment kills harmful microorganisms.

2.3 COMMON GASTROINTESTINAL DISORDERS

1. Gastroesophageal Reflux Disease (GERD)

GERD is the backflow of stomach acid into the oesophagus due to the weakening of the lower oesophageal sphincter.

> Lower oesophageal sphincter is a ring of muscles at the lower end of oesophagus. It acts as a valve, preventing stomach contents from flowing back up into the oesophagus.

Symptoms: Heartburn (burning sensation in the chest), acid reflux, difficulty in swallowing and chronic cough or sore throat etc.

Causes and Risk Factors: Obesity, smoking, eating large meals before bed, eating spicy or acidic foods.

Treatment: Lifestyle changes (e.g., avoiding trigger foods), medications and in severe cases, surgery.

2. Peptic Ulcer

A peptic ulcer is an open sore that forms on the inner lining of the stomach, small intestine (duodenum), or oesophagus.

Symptoms: Burning abdominal pain, bloating and nausea, vomiting or black stools.

Causes and Risk Factors: Infection by *Helicobacter pylori* bacteria in stomach, long-term use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), excessive alcohol consumption, smoking, stress, spicy foods.

Treatment: Antibiotics, dietary modifications.

Impact of GI Disorders on Daily Life

- **GI disorders** like peptic ulcers and GERD cause persistent abdominal pain, bloating, and discomfort.
- **Liver disease** can cause malabsorption of nutrients leading to fatigue, weakness, and low energy.
- **GI disorders** can cause discomfort at night, leading to disrupted sleep patterns.
- Some GI disorders involve chronic inflammation of the digestive tract,

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leading to long-term health issues.

2.4 INFECTIOUS DISEASES OF THE GI TRACT

1.Cholera

- **Pathogen:** *Vibrio cholerae* (a bacterium)
- **Transmission:** Cholera is primarily transmitted through contaminated **water** or **food**.
- **Symptoms:** Severe diarrhoea, vomiting, dehydration, muscle cramps, fatigue.
- **Complications:** Severe dehydration can lead to shock, kidney failure and electrolyte imbalances due to fluid loss.

2.Typhoid Fever

- **Pathogen:** *Salmonella typhi* (a bacterium)
- **Transmission:** Typhoid fever is transmitted through contaminated food or water, or by close contact with an infected person.
- **Symptoms:** Fever, abdominal pain, diarrhoea or constipation, loss of appetite, headache, weakness and fatigue, rose spots.
- **Complications:** Intestinal perforation or bleeding, which can lead to infection of the abdominal cavity; liver or spleen enlargement.

3. Gastroenteritis

- **Pathogens:** Several viruses, bacteria, and parasites can cause gastroenteritis:

  Viruses: For example, rotavirus.

  Bacteria: For example, *Escherichia coli* (*E. coli*).

  Parasites: For example, *Entamoeba histolytica*.

- **Transmission:** Gastroenteritis is commonly transmitted through contaminated food and water.
- **Symptoms:** Diarrhoea, nausea and vomiting, abdominal cramps, fever.
- **Complications:** Severe dehydration and electrolyte imbalances.

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Preventive Measures for GI Infections

Preventive measures for gastrointestinal (GI) infections include:

- Washing hands thoroughly with soap before eating and after using the toilet.
- Storing food properly in a refrigerator.
- Drinking only purified, boiled, or bottled water.
- Avoiding consumption of undercooked food.
- Vaccination against rotavirus.
- Eating a balanced diet and staying hydrated.

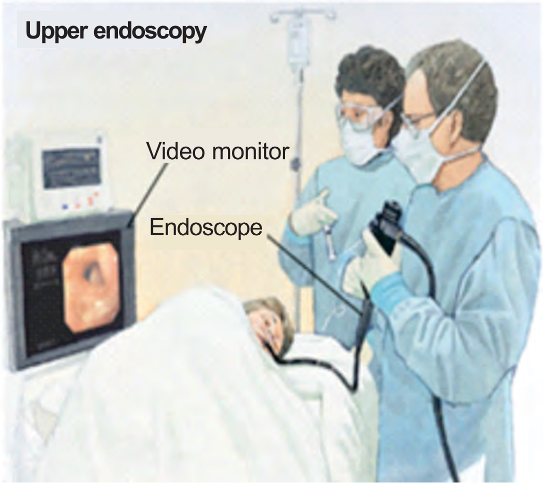
2.6 DIAGNOSTIC AND THERAPEUTIC APPROACHES

1. Blood Tests

- **Complete Blood Count (CBC)** can identify signs of GI infections. For example, increased white blood cell count suggests bacterial infection.
- **Liver Function Tests (LFTs)** measure enzymes and proteins in the blood. LFTs helps to evaluate the function of the liver and detect liver disease or hepatitis.

2. Imaging

- **X-rays** can be used to visualize the outline of the stomach or intestines.
- **CT (Computed Tomography) Scan** provides detailed images of the abdomen and is used to detect tumours, inflammatory conditions, or blockages in the GI tract.
- **MRI** (Magnetic Resonance Imaging) offers detailed images for detecting conditions like liver disease or pancreatic disorders.
- **Ultrasound** is used to diagnose the diseases of the liver, gallbladder, and pancreas.



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3. Endoscopy

It is a procedure that uses a flexible tube with a camera (endoscope) to visually examine the inside of the gastrointestinal tract. It is used to diagnose the disorders of GI tract.

EXERCISE

A. Select the correct answers for the following questions.

1. The function of the small intestine is:
   a) Absorption of water b) Absorption of nutrients
   c) Secretion of bile d) Storage of waste
2. Which organ produces bile?
   a) Pancreas b) Stomach
   c) Liver d) Small intestine
3. Which diagnostic procedure uses a flexible tube to examine the GI tract?
   a) X-ray b) Endoscopy
   c) MRI d) CT scan
4. What role does the liver play in digestion?
   a) Absorbing nutrients
   b) Producing digestive enzymes
   c) Producing bile
   d) Breaking down proteins
5. What is the main function of the large intestine?
   a) Digest proteins
   b) Absorb water and electrolytes
   c) Break down fats
   d) Produce digestive enzymes
6. Which pathogen causes typhoid fever?
   a) Vibrio cholerae b) Salmonella Typhi
   c) E. coli d) Entamoeba histolytica
7. Which of the following is a risk factor for GERD?
   a) Eating large meals before bed b) Excessive fibre intake
   c) Drinking water frequently d) High intake of protein

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B. Write short answers.

1. Define peptic ulcer and GERD.
2. What is the function of the villi in the small intestine?
3. How is the typhoid fever transmitted?
4. What are the common symptoms of peptic ulcers?
5. What are some preventive measures for cholera?

C. Write answers in detail.

1. Discuss the functions of major organs of the GI system.
2. Describe the causes, symptoms, and treatments for GERD and peptic ulcer.
3. Write pathogens, transmission, symptoms and complications of cholera, typhoid fever, and gastroenteritis.
4. Discuss the role of diagnostic tools (e.g., blood tests, imaging, endoscopy) in diagnosing GI disorders.

Group Activities

1. Write a reflective note on the importance of early diagnosis in managing GI diseases.

Practical Activities

1. Identify and label parts of GI system on models/diagrams.

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Chapter 3

RESPIRATORY SYSTEM

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Describe the process of gas exchange in the alveoli and the role of the diaphragm in breathing.
- Explain the causes, symptoms, and risk factors of respiratory disorders like asthma, COPD, and pneumonia.
- Describe the transmission, symptoms, and prevention of respiratory infections (e.g., TB, influenza, COVID-19).
- Identify the major structures of the respiratory system using diagrams or models.
- Develop a public health poster on preventing respiratory infections like TB and influenza.
- Role-play a patient consultation to explain the purpose of a diagnostic test like a chest X-ray.
- Design a community awareness campaign on the dangers of smoking and air pollution, and prevention of respiratory infections (e.g., TB, influenza, COVID-19).
- Explain the pathophysiology and clinical presentation of these critical conditions.
- Briefly describe the principles of pulmonary function tests, imaging techniques, and oxygen therapy.
- Describe the role of vaccination (e.g., flu, pneumonia) and smoking cessation in respiratory health.

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In this chapter we will study the functions of the respiratory system, as well as common respiratory disorders. We will also explore the diagnostic tests for respiratory infections.

3.1 FUNCTION OF RESPIRATORY SYSTEM

The respiratory system is responsible for taking in oxygen and expelling carbon dioxide out of the body.

- **Air enters** the nose which filters, warms and humidifies incoming air. Nose has tiny hairs and mucus which trap the dust and other harmful particles.
- Air enters the pharynx which plays a vital role in directing it to the lungs.
- From pharynx, air goes into the larynx. The larynx contains the vocal cords, which facilitate speech. **Glottis** is a narrow opening at the floor of pharynx which leads into larynx. The glottis is guarded by a flap of tissue called the **epiglottis** which prevents food from entering the trachea, reducing the risk of choking.
- Larynx continues to the trachea, which is also called the windpipe. There are C-shaped cartilaginous rings in the wall of trachea. Tiny hair-like structures called cilia line its walls and help remove bacteria and excess mucus, keeping the airway clear.
- The trachea divides into two main bronchi, each leading to a lung. These bronchi further branch into smaller bronchioles. The bronchi contain smooth muscles that can contract or expand to regulate airflow.
- The bronchioles end as fine tubules called the alveolar ducts. Each alveolar duct opens into a cluster of pouches called alveoli where gas exchange takes place. Oxygen from inhaled air diffuses into the bloodstream, while carbon dioxide is expelled from the blood into the alveoli to be exhaled.
- **Diaphragm & Breathing Muscles:** The diaphragm is a dome-shaped muscle present below the lungs. It contracts and relaxes to facilitate breathing. It works in coordination

> Nose hairs, mucus, and cilia trap dust, bacteria, and other harmful particles before they reach the lungs.

> To make room for the heart, the left lung is slightly smaller than the right lung.

> The average human takes about 16 breaths per minute, which adds up to more than 20,000 breaths per day.

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with intercostal muscles located between the ribs to regulate lung expansion and contraction.

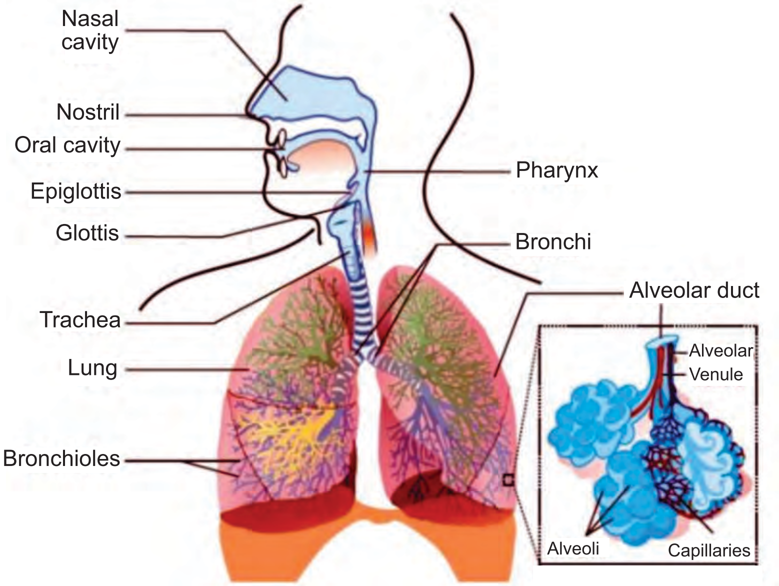

FIGURE 3.1: Human Respiratory system

3.2 COMMON RESPIRATORY DISORDERS

1. Asthma

It is a chronic condition where the airways become inflamed and narrowed, leading to breathing difficulties.

- **Symptoms:** Wheezing, persistent coughing, chest tightness, and shortness of breath.
- **Causes:** Allergens e.g., dust and pollen, air pollution, and genetics.
- **Treatment:** Inhalers and medications and avoiding known triggers.

2. Chronic Obstructive Pulmonary Disease (COPD)

It is a progressive disease that obstructs airflow and reduces lung function over time.

- **Symptoms:** Chronic cough, difficulty breathing, excessive mucus production, and fatigue.
- **Causes:** Smoking, long-term exposure to air pollutants, and genetic factors.

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- **Prevention:** Avoiding smoking, maintaining air quality, and undergoing regular medical check-ups.
- **Treatment:** Inhalers, anti-inflammatory medicines and oxygen therapy.

3. Pneumonia

It is a lung infection that causes inflammation and fluid build-up in the alveoli, making breathing difficult.

- **Symptoms:** Fever, cough, chest pain, difficulty breathing, chills, and fatigue.
- **Causes:** Bacteria, viruses, or fungi.
- **Treatment:** Antibiotics (for bacterial pneumonia), antiviral medications (for viral pneumonia), antifungal medications (for fungal pneumonia), and oxygen therapy in severe cases.

3.3 INFECTIOUS DISEASES OF THE RESPIRATORY SYSTEM

1. Tuberculosis (TB)

It is a bacterial infection caused by *Mycobacterium tuberculosis*. It spreads through the air when an infected person coughs, sneezes, or talks, releasing tiny droplets containing the bacteria.

- **Symptoms**: **Coughing** (lasting more than 3 weeks), chest pain, fever, night sweats, fatigue, weight loss and shortness of breath.
- **Prevention**: BCG vaccination, covering the mouth while coughing or sneezing and ensuring good airflow in living spaces.
- **Treatment:** Early detection and proper antibiotic therapy.
- **Pathophysiology:** TB primarily affects the lungs, but it can spread to other organs. The bacteria cause inflammation.
- **Clinical Presentation:** Symptoms are often gradual, with a persistent cough, fever, blood in cough, fatigue, and weight loss.

2. Influenza (Flu)

It is a viral infection caused by influenza virus which spreads through respiratory droplets when an infected person coughs, sneezes, or talks.

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Symptoms: Fever, chills, cough, sore throat, runny nose, muscle aches, fatigue and headache.

Prevention: Getting annual flu vaccines, frequent hand washing, covering the mouth while coughing, using tissues or elbows to prevent virus spread; avoiding close contact with infected individuals, especially during peak flu season.

Pathophysiology: The influenza virus infects the epithelial cells of the respiratory tract, causing inflammation, and cellular damage.

Clinical Presentation: Symptoms can appear suddenly and include fever, chills, fatigue, body aches, and respiratory symptoms. Severe cases may lead to pneumonia.

3. COVID-19 (Coronavirus Disease 2019)

It is a viral infection caused by the SARS-CoV-2 virus, which spreads through respiratory droplets when an infected person coughs, sneezes, talks, or breathes. It can also spread via contaminated surfaces.

- **Symptoms:** Fever, chills, cough, shortness of breath, fatigue, muscle aches, headache and loss of taste or smell (a key distinguishing symptom).
- **Prevention: Getting** COVID-19 vaccines, wearing masks, regular handwashing or using hand sanitizer, avoiding close contact with infected person and quarantine (isolating infected individuals).
- **Pathophysiology**: SARS-CoV-2 primarily infects the respiratory system.
- **Clinical Presentation**: COVID-19 symptoms can range from mild to severe. Common symptoms include fever, cough, shortness of breath, and fatigue.

3.4 DIAGNOSTIC AND TREATMENT METHODS

1. Pulmonary Function Tests (PFTs)

Pulmonary function tests assess the performance of the lungs. These tests measure lung volume, airflow, and the efficiency of gas exchange. They provide information on conditions like asthma and chronic obstructive pulmonary disease (COPD) etc.

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Figure 3.2: Pulmonary Function Test

2. Imaging Techniques

Imaging techniques provide detailed visualizations of the lungs and respiratory system to diagnose diseases, detect structural abnormalities, and monitor treatment progress.

Common Imaging Techniques are chest X-ray, CT scan (Computed Tomography), MRI (Magnetic Resonance Imaging) and Ultrasound.

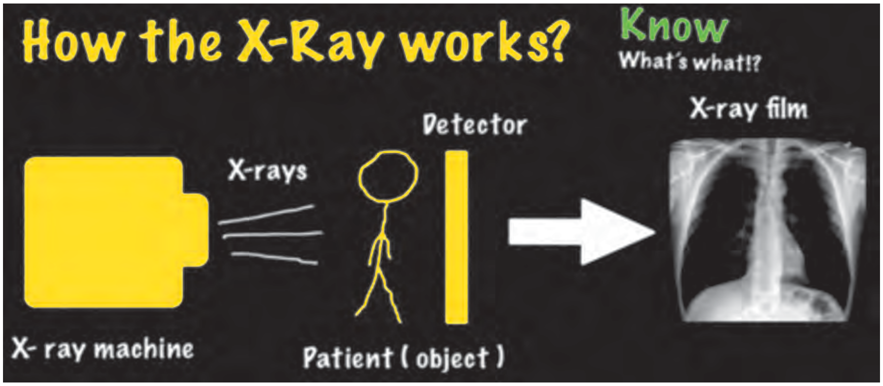

Figure 3.3: X-ray

3. Oxygen Therapy

Oxygen therapy involves providing supplemental oxygen to patients who have low blood oxygen levels. This improves tissue oxygenation and helps in managing the conditions like chronic respiratory diseases, heart failure, and

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acute hypoxia.

3.5 VACCINATION AND SMOKING CESSATION

Vaccination and smoking cessation are key to maintaining respiratory health.

Vaccination

- **Flu Vaccine** reduces the risk of severe illness and complications from the flu.
- **Pneumonia Vaccine** prevents bacterial pneumonia, reducing the risk of complications and hospitalizations.
- **TB Vaccines** like the BCG help prevent chronic lung infections.

Smoking Cessation

- Quitting smoking helps repair lung damage and improves lung function.
- Smoking cessation lowers the risk of chronic diseases like COPD and lung cancer.
- Smoking weakens the immune system, so quitting reduces the risk of infections like pneumonia and bronchitis.
- Quitting smoking improves overall health, including better circulation, stronger immune function, and a higher quality of life.

EXERCISE

A. Select the correct answers for the following questions.

1. Which part of the respiratory system is responsible for gas exchange?
   a) Trachea b) Bronchi c) Alveoli d) Pharynx
2. What is the function of the diaphragm?
   a) To filter the air b) To exchange gases
   c) To control the expansion and contraction of the lungs
   d) To produce mucus
3. How does pneumonia affect the lungs?
   a) It fills the alveoli with fluid b) It removes mucus from the airways
   c) It increases oxygen levels in the blood
   d) It strengthens the lung tissues

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4. Which respiratory infection can spread through contaminated surfaces and direct contact?

   a) Tuberculosis b) COVID-19 c) Asthma d) Pneumonia

5. What is the mode of transmission for influenza?

   a) Mosquito bites
   b) Direct contact with contaminated blood
   c) Respiratory droplets from coughs and sneezes
   d) Insect bites

6. What is a common symptom of tuberculosis?

   a) Short-term headache
   b) Persistent cough lasting more than three weeks
   c) Skin rash
   d) Increased appetite

7. Which of the following is the best way to prevent the spread of COVID-19?

   a) Taking antibiotics regularly
   b) Wearing masks and practicing social distancing
   c) Avoiding all fruits and vegetables
   d) Sleeping for more than 12 hours a day

8. Which of the following can be diagnosed using pulmonary function tests?

   a) Diabetes b) Asthma and COPD
   c) Liver cirrhosis d) High blood pressure

9. Which imaging technique uses strong magnetic fields and radio waves to create detailed images of soft tissues in the lungs?

   a) CT scan b) MRI c) PET scan d) X-ray

10. Which condition may require oxygen therapy?

   a) Anaemia
   b) Chronic respiratory diseases
   c) High blood sugar
   d) Kidney stones

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B. Write short answers.

1. How does the process of gas exchange take place in the alveoli?
2. Discuss the symptoms and causes of asthma.
3. What is the significance of vaccination in preventing respiratory infections like influenza and COVID-19?
4. Identify the pathophysiology and clinical presentation of chronic obstructive pulmonary disease (COPD).
5. Write the names of the diagnostic methods used to evaluate lung function and respiratory conditions.

C. Write answers in detail.

1. Discuss the function of the respiratory system.
2. Explain the transmission, symptoms, prevention and treatment for TB, influenza and COVID-19.
3. Describe the role of pulmonary function tests (PFTs) and imaging techniques in diagnosing respiratory conditions.
4. Describe the key symptoms and treatment options for pneumonia and how it differs from other respiratory infections.

Group Activities

1. Identify the major structures of the respiratory system using diagrams/models.
2. Develop a public health poster on preventing respiratory infections like TB and influenza.
3. Design a community awareness campaign on the dangers of smoking and air pollution, and prevention of respiratory infections (e.g., TB, influenza, COVID-19).
4. Role-play a patient consultation to explain the purpose of a diagnostic test like a chest X-ray.

Practical Activities

1. **Nebulization Therapy:** Use a nebulizer to give medication to the lungs, helping treat conditions like asthma or COPD.

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2. **Pulmonary Function Test:** Measure how much air you can breathe in and out to check how well your lungs work.
3. **Assessment of Respiratory Rate:** Count how many breaths a person takes in one minute to check their breathing rate.
4. **Use of Stethoscope to Identify Breathing Sounds:** Use a stethoscope to listen to lung sounds and identify any problems like wheezing or crackling.
5. **CO_2 & Lime Water Test (Exhaled Air Experiment):** Blow air into lime water and see how it changes color, showing the presence of carbon dioxide in exhaled air.
6. **Use of Pulse Oximeter to Measure Oxygen Saturation:** Use a pulse oximeter to check how much oxygen is in a person's blood.

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Chapter 4

CIRCULATORY SYSTEM

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Describe the role of the circulatory system in transporting materials.
- Explain the causes, symptoms, and risk factors of hypertension, coronary artery disease, and heart failure.
- Briefly describe the principles of diagnostic tests like ECGs, stress tests, and angiograms.
- Describe the role of lifestyle changes (e.g., diet, exercise, smoking cessation) in preventing heart disease.
- Identify the major components of the circulatory system using diagrams or models.
- Role-play a patient consultation to explain the purpose of a diagnostic test like an ECG.
- Design a community awareness campaign on the importance of heart health.

In this chapter, we will study the circulatory system and its functions. We will also explore the common cardiovascular disorders and their diagnostic tests.

4.1 FUNCTION OF THE CIRCULATORY SYSTEM

The circulatory system consists of the heart, blood vessels, and blood. These components work together to ensure that vital substances are circulated throughout the body to keep it functioning properly.

Heart

The heart is a muscular organ that acts as a pump to circulate blood through the body.

> Exercise makes the heart more efficient. A regular exerciser's heart beats around 40-60 times per minute, while an untrained person's heart beats about 70-100 times per minute.

The heart is divided into four chambers: two atria (upper chambers) and two ventricles (lower chambers). The **right atrium** of the heart receives deoxygenated blood from the body and **right ventricle** pumps it to the lungs, where it is oxygenated. The **left atrium** of the heart receives oxygenated blood from the lungs and **left ventricle** pumps it to the rest of the body.

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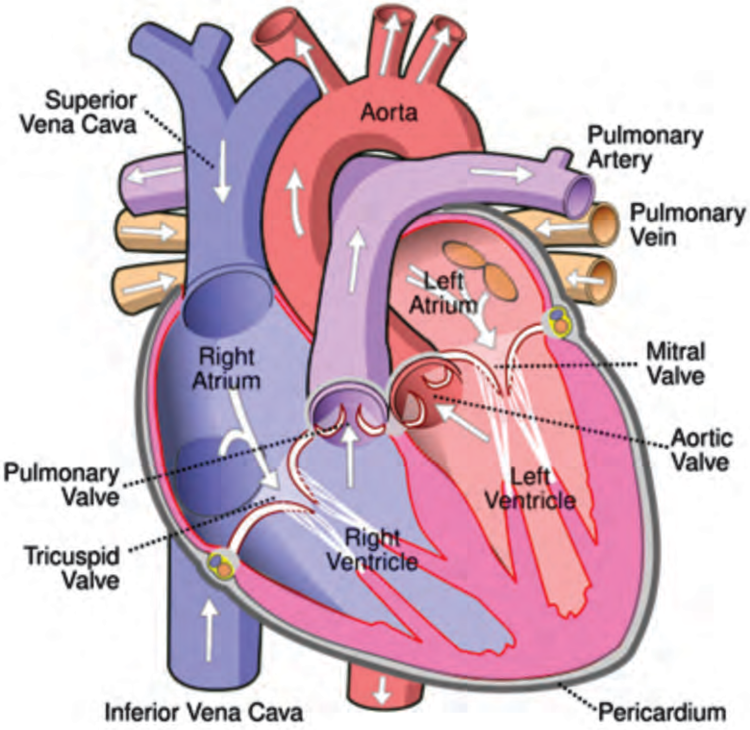

Figure 4.1: Heart

Blood Vessels

Blood vessels are responsible for carrying blood to and from the heart. They include:

- **Arteries** carry blood away from the heart to the tissues. The largest artery is the aorta, which carries blood to the entire body. All arteries carry oxygenated blood except pulmonary arteries which carry deoxygenated blood.

> The aorta is the largest artery in the body and can carry about 20-30 liters of blood per minute.

- **Veins** return blood to the heart. The largest vein is the vena cava, which brings blood back from the body into the right atrium. All veins carry deoxygenated blood except pulmonary veins which carry oxygenated blood.
- **Capillaries** are tiny, thin-walled vessels where the exchange of gases, nutrients, and waste products occurs between the blood and tissues.

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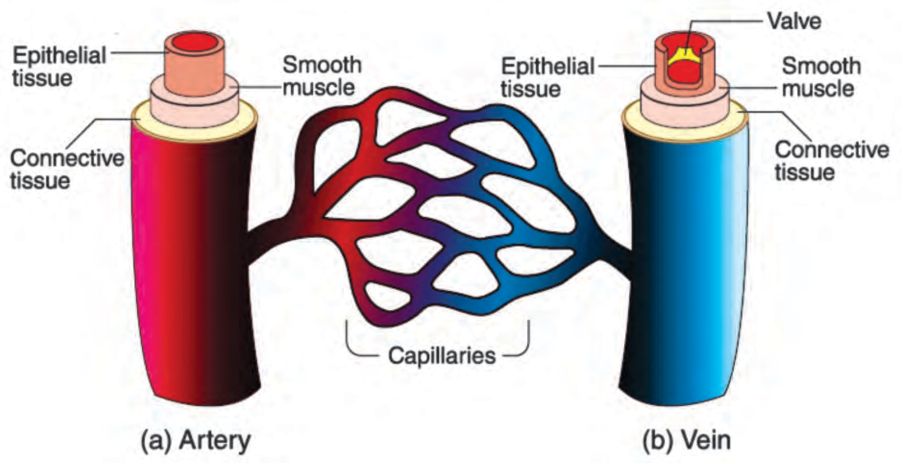

Figure 4.2: Types of Blood vessels

Blood

Blood is composed of plasma (the liquid component), red blood cells (carry oxygen), white blood cells (involved in immune responses), and platelets (help in clotting). Blood plays a central role in transporting oxygen and nutrients to cells and waste products (carbon dioxide, urea) from cells to lungs and kidneys.

> Blood cells are produced in the bone marrow. Red blood cells live for about 120 days before being replaced.

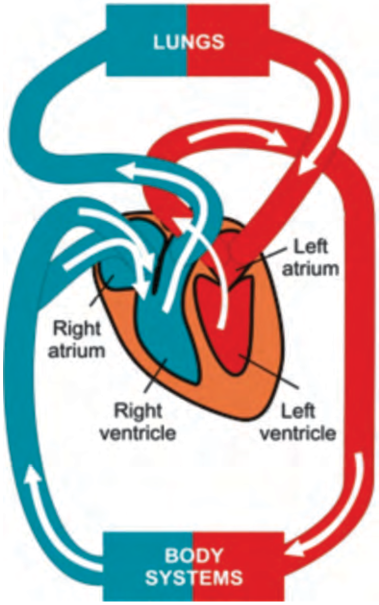

Figure 4.3: Circulatory system

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4.2 COMMON CARDIOVASCULAR DISORDERS

Cardiovascular diseases (CVDs) are the conditions that affect the heart and blood vessels. The most common cardiovascular disorders include hypertension, coronary artery disease, and heart failure.

Hypertension (High Blood Pressure)

Hypertension is a condition when the blood pressure in the arteries is continuously too high.

Causes: Excessive salt intake, obesity, lack of exercise, stress, etc.

Symptoms: Often referred to as the "silent killer" because it usually has no symptoms. However, headaches, dizziness, nosebleeds, blurred vision, and shortness of breath are considered some of its common symptoms.

Risk Factors: Family history, advanced age, obesity, high salt intake, smoking, alcohol consumption, sedentary lifestyle, stress, diabetes, kidney disease, etc.

Coronary Artery Disease (CAD)

CAD is a condition in which the coronary arteries (which supply blood to the heart) become narrow or blocked due to the buildup of plaques. This reduces blood flow and oxygen supply to the heart muscle.

> Plaque is a sticky, fatty deposit inside the walls of arteries.

Causes: High cholesterol, hypertension, smoking, diabetes, obesity, lack of exercise, unhealthy diet, stress, family history, etc.

Symptoms: Chest pain (angina), shortness of breath, fatigue, palpitations, dizziness, etc.

Risk Factors: High cholesterol, hypertension, smoking, diabetes, sedentary lifestyle etc.

> People with heart failure often feel very tired because the heart is not pumping enough oxygenated blood to the body's organs.

Heart Failure

Heart failure is a condition when the heart fails to pump blood efficiently to meet the body's needs.

Causes: Coronary artery disease, hypertension, or a prior heart attack that has damaged the heart muscle.

Symptoms: Shortness of breath, fatigue, swelling in the legs, irregular heartbeat, etc.

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Risk Factors: Coronary artery disease, high blood pressure, diabetes, obesity, advanced age, etc.

4.3 DIAGNOSTIC TESTS

Electrocardiogram (ECG)

This test measures the electrical activity of the heart. An ECG is used to detect irregular heartbeats, heart attacks, and other heart conditions.

Principle: Small electrodes are attached to the skin. They detect electrical signals passing through the heart.

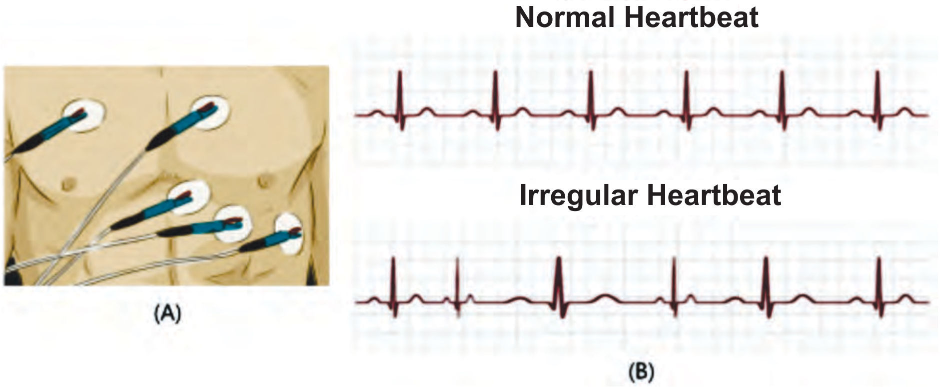

Figure 4.4: (A)- Location of electrodes for ECG; (B)- ECG readings

Stress Test

A stress test evaluates how well the heart functions during physical exertion. It can reveal coronary artery disease and other heart conditions.

Principle: The patient exercises on a treadmill or stationary bike while the heart rate, blood pressure, and ECG are monitored.

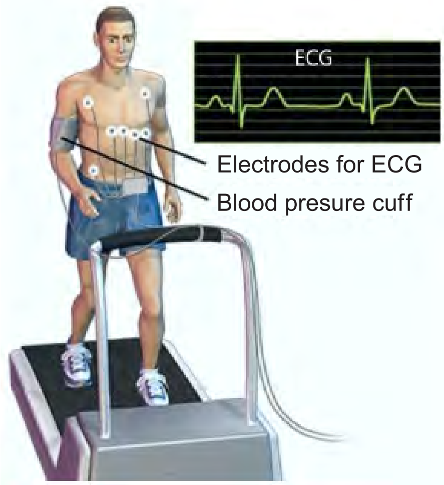

Figure 4.5: Stress test

Angiogram

An angiogram is used to examine the blood vessels, particularly the coronary arteries, for blockages.

Principle: A contrast dye is injected into the blood vessels, and X-ray imaging is used to visualize the blood flow.

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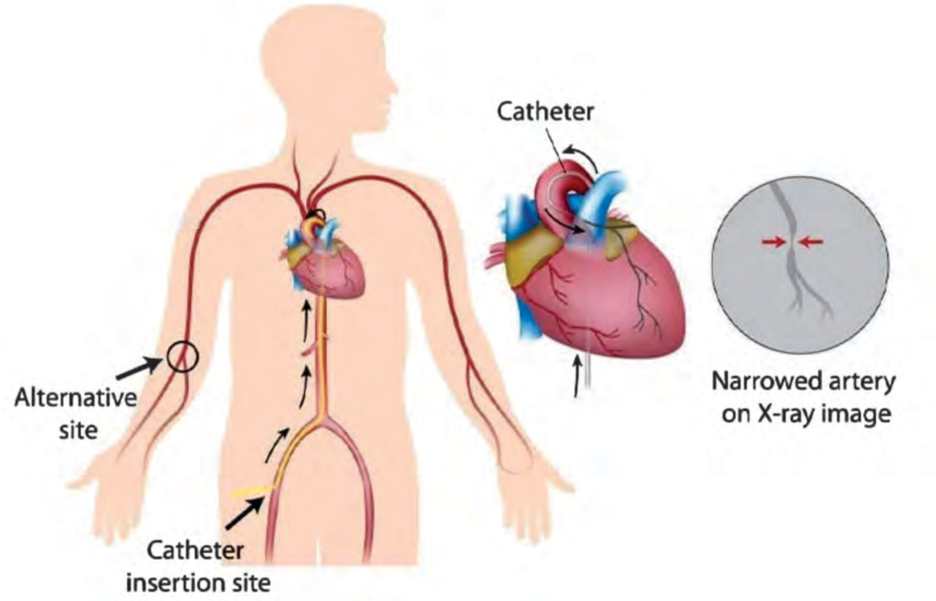

Figure 4.6: (A)- Procedure of angiogram; (B)- Visualization of blood flow

4.3 PREVENTION OF CARDIOVASCULAR DISEASES

Preventing cardiovascular diseases is a critical public health priority. Lifestyle changes, regular health screening, and public health campaigns can significantly reduce the incidence of heart disease.

Prevention Strategies

Diet: A healthy diet can reduce the risk of heart disease. A balanced diet, which emphasizes fruits, vegetables, nuts, and healthy fats (like olive oil) improves cardiovascular health. Processed foods, excessive sugar, and unhealthy fats should be avoided.

Exercise: Regular physical activity, such as walking, swimming, or cycling, helps to reduce blood pressure, improve cholesterol levels, and control body weight.

Quitting Smoking: Quitting smoking helps reduce the risk of heart disease, stroke, and lung disease.

Regular Health Screenings: Routine check-ups for blood pressure, cholesterol, and blood sugar levels can detect potential cardiovascular disorders.

Stress Management: Techniques like mindfulness, relaxation exercises, and adequate sleep can help reduce stress, which contributes to hypertension.

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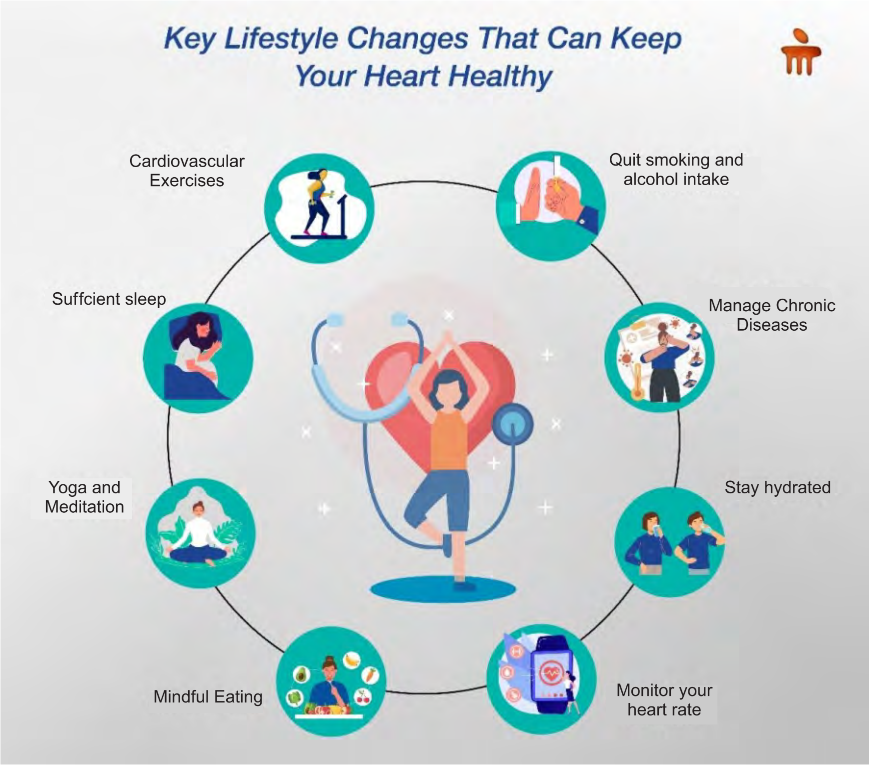

Figure 4.7: Life style for a healthy Heart

EXERCISE

A. Select the correct answers for the following questions.

1. What is the main function of the circulatory system?
   a) To filter waste products
   b) To transport oxygen and nutrients
   c) To regulate body temperature
   d) To digest food
2. Which blood vessels carry blood away from the heart to the other parts of the body?
   a) Veins   b) Arteries
   c) Capillaries   d) Lymphatic vessels

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3. What is the term for high blood pressure?
   a) Coronary artery disease b) Heart failure
   c) Hypertension d) Angina
4. Which of the following is a risk factor for coronary artery disease?
   a) Regular exercise b) High cholesterol
   c) Low blood pressure d) Healthy diet
5. Which diagnostic test measures the electrical activity of the heart?
   a) Angiogram b) Stress test
   c) ECG (Electrocardiogram) d) X-ray
6. What is a common symptom of heart failure?
   a) Chest pain b) Shortness of breath
   c) Nausea d) Increased appetite
7. Which lifestyle change can help prevent heart disease?
   a) Smoking
   b) Eating a high-fat diet
   c) Regular physical activity
   d) Excessive alcohol consumption
8. An angiogram helps in diagnosing heart conditions by:
   a) Using sound waves to check heart function
   b) Monitoring electrical signals of the heart
   c) Detecting the presence of blockages in blood vessels
   d) Measuring blood pressure over time
9. What is a major complication of untreated hypertension?
   a) Heart attack b) Low blood sugar
   c) Excessive sweating d) Weight loss

B. Write short answers.

1. What is the function of capillaries in the circulatory system?
2. Write the risk factors for hypertension.
3. Define coronary artery disease and its primary cause.
4. What is an ECG, and what does it measure?

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1. Describe the function of the heart.
2. Write note on the causes, symptoms, and treatment for hypertension.
3. Discuss the causes, symptoms, and treatment options for heart failure.
4. Describe the diagnostic tests used to assess heart function and how they help in diagnosing cardiovascular conditions.

Group Activities

1. Make a presentation on the impact of lifestyle choices on cardiovascular health and preventive measures.
2. Identify the major components of the circulatory system using diagrams or models.
3. Design a community awareness campaign on the importance of heart health.

Practical Activities

1. Role-play a patient consultation to explain the purpose of a diagnostic test like an ECG.
2. **Heart Rate Measurement:** Measure the number of heart beats per minute during rest and after exercise.
3. **Pulse Measurement:** Check the pulse at different points on the body to evaluate heart rate.
4. **Use of Sphygmomanometer:** Use a sphygmomanometer to measure blood pressure.
5. **Use of Stethoscope for Heart Sounds:** Use a stethoscope to listen to heart sounds.
6. **Use of Pulse Oximeter:** Use a pulse oximeter to measure blood oxygen levels.

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Chapter 5 URINARY SYSTEM

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Describe the role of the urinary system in filtration, waste removal, and fluid balance.
- Explain the causes, symptoms, and risk factors of urinary disorders (like UTIs, kidney stones, and urinary incontinence).
- Describe the causes, symptoms, and complications of kidney diseases like AKI, and CKD.
- Describe the transmission, symptoms, and prevention of infections of urinary system (e.g., pyelonephritis, cystitis, urethritis).
- Briefly describe the principles of diagnostic tests like urinalysis, blood tests, and imaging techniques.
- Identify the major structures of the urinary system using diagrams or models.
- Interpret lab results (e.g., serum creatinine, GFR) to assess kidney function.
- Develop a public health poster on preventing UTIs.
- Justify the importance of early diagnosis in managing urinary diseases.
- Role-play a patient consultation to explain the purpose of a diagnostic test like a kidney ultrasound.

The urinary system plays a crucial role in maintaining the body's internal balance. In this chapter, we will explore the importance of the urinary system, common disorders, diagnostic techniques, and strategies for maintaining urinary health.

5.1 THE URINARY SYSTEM

The following is a brief description of the human urinary system (excretory system).

The urinary system consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra. The **kidneys** remove extra water, salts and nitrogenous wastes from blood and make urine. From each kidney, a tube called **ureter** carries urine to the urinary bladder. The **urinary bladder** temporarily stores urine. The **urethra** is the tube that carries urine from the urinary bladder to the outside.

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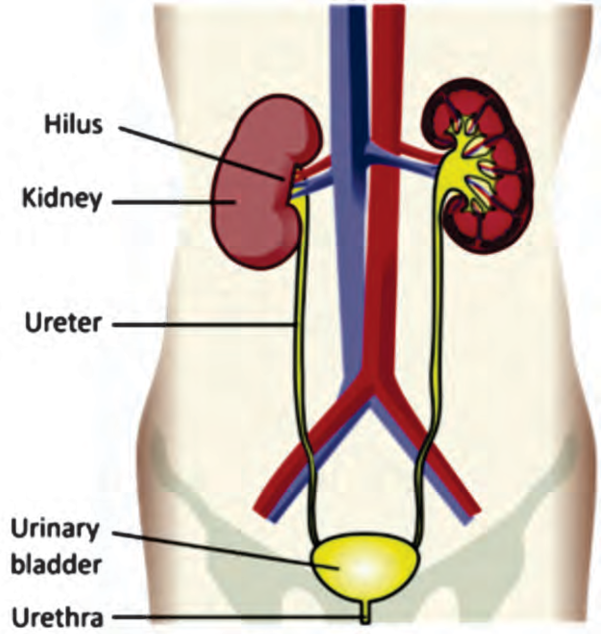

Figure 5.1: The Urinary System

Role of the Urinary System in Homeostasis

The urinary system plays a vital role in maintaining homeostasis. Homeostasis is defined as the body's ability to keep internal conditions stable despite external changes. The urinary system regulates waste elimination, fluid balance, and blood composition.

1- Waste Filtration and Removal

A key function of the urinary system is waste filtration i.e., removal of harmful substances like urea, excess salts, and toxins from blood while preserving essential components. This process helps to maintain the internal chemical balance.

> Despite their small size, the kidneys are powerful organs. Kidneys filter about 50 gallons of blood every single day!

2- Fluid Balance

The urinary system adjusts water levels in the body fluids. It prevents dehydration or fluid overload. When we drink a lot of water, the urinary system makes more urine to remove the extra water. When we do not drink enough, the urinary system makes less urine and saves water. This process also helps to keep blood pressure normal.

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By doing the above functions, the urinary system keeps the internal conditions stable. It allows cells and organs to function efficiently.

5.2 COMMON URINARY DISORDERS

The urinary system can be affected by various disorders like urinary tract infections (UTIs), kidney stones, and urinary incontinence.

1. Urinary Tract Infections (UTIs)

A UTI occurs when bacteria, most commonly *Escherichia coli* (*E. coli*), enter the urinary tract and cause infection. UTI can affect different parts of the urinary system, including the kidneys (pyelonephritis), bladder (cystitis), or urethra (urethritis).

> If a UTI is limited to the bladder, it can be painful. But serious health problems can result if a UTI spreads to the kidneys.

Causes: Bacterial entry through the urethra, poor hygiene, dehydration, holding urine for too long, or sexual activity.

Transmission of Pyelonephritis

- Most cases begin as a lower UTI, where bacteria from the bladder travel up to the kidneys.
- In rare cases, bacteria from an existing infection in the body can spread to the kidneys through the blood.

Transmission of Cystitis

- Poor hygiene, sexual activity, or using contaminated toilet seats can introduce bacteria into the bladder.
- Long-term use of urinary catheters increases infection risk.

Transmission of Urethritis

- Sexually transmitted infections (STIs) by bacteria *Chlamydia* and *Gonorrhea* are common causes of urethritis.
- Other bacteria can enter the urethra due to poor hygiene or contaminated medical instruments.

Symptoms of UTIs: The following table describes the common signs and symptoms of the UTIs of different parts of the urinary system.

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Table: Signs and Symptoms of UTIs	
Part affected by UTI	**Signs and symptoms**
Kidneys (pyelonephritis)	• Back or side pain • High fever • Shaking and chills • Nausea and Vomiting
Bladder (cystitis)	• Pelvic pressure • Lower belly discomfort • Frequent, painful urination • Blood in urine
Urethra (urethritis)	• Burning with urination • Urine discharge

Risk Factors of UTIs: Weakened immune system, pregnancy, diabetes, and improper hygiene.

Treatment of UTIs

- Antibiotics to kill the bacteria.
- Increased fluid intake to flush out bacteria.
- Pain relievers to ease discomfort.

2. Kidney Stones

Kidney stones are hard lumps made of minerals and salts that form in the kidneys. They can block the urinary tract and cause strong pain. Sometimes, they move out of the kidneys but get stuck in the ureter or bladder.

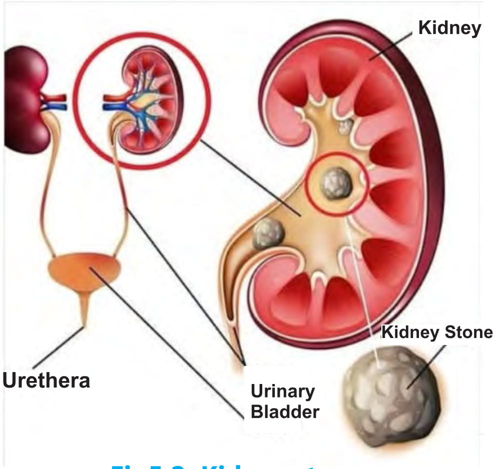

Fig5.2: Kidney stones

Causes of kidney stones: Dehydration, high intake of oxalate-rich foods (e.g., spinach, nuts), excess vitamins C and D in diet, excess uric acid in blood, and metabolic disorders.

Symptoms of kidney stones: Intense pain in the lower back or abdomen,

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nausea, vomiting, blood in urine, and difficulty urinating.

Risk Factors of kidney stones: Family history, low water intake, high-protein or high-sodium diet, obesity, and recurrent UTIs.

Treatment: of kidney stones

Hydration therapy: Drinking plenty of water to help pass small stones naturally through urine.

Medications: Alpha-blockers relax the ureter muscles and aid stone passage.

Lithotripsy: Shock waves are fired on the kidney from outside. The waves break the stones into smaller pieces, which pass out through urine.

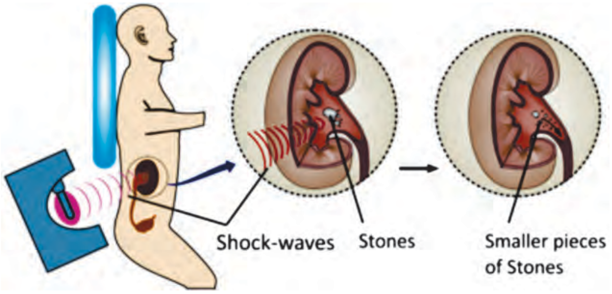

Figure 5.3: Lithotripsy

Surgery: In severe cases, large stones may be surgically removed.

Ureteroscopy: A ureteroscope is a thin, flexible tube with a camera and light at the tip. It is passed through the urethra to see and remove stones from the kidney or ureter. Small forceps or a tiny "basket" at the end of the ureteroscope help in pickinc

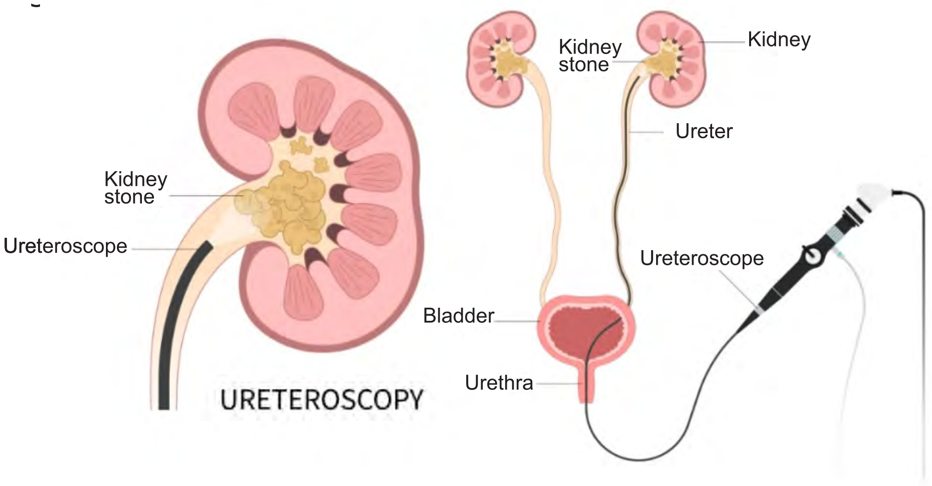

Figure 5.4: Ureteroscopy

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3. Urinary Incontinence

Urinary incontinence is a condition when a person cannot control urine leakage. It can usually happens in old age. There are two common types. **Stress incontinence** happens when activities like coughing or sneezing put pressure on the bladder. **Urge incontinence** happens due to sudden, strong need to urinate.

Maintaining good hydration, a balanced diet, proper hygiene, and regular medical check-ups can significantly reduce the risk of urinary health problems.

Causes of urine incontinence: Weak pelvic muscles, nerve damage, obesity, pregnancy, and neurological disorders (e.g., stroke, Parkinson's disease).

Symptoms of urine incontinence: Loss of bladder control, frequent urination, sudden urgency, or accidental leakage during physical activities.

Risk Factors of urine incontinence: Aging, obesity, pregnancy, menopause, and chronic conditions like diabetes.

The bladder can expand up to five times its empty size! – A healthy bladder can hold about 400–600 mL of urine before signalling the brain that it's time to empty.

Treatment of urine incontinence

Lifestyle changes: Reducing caffeine and alcohol intake and managing fluid intake and avoiding excessive water before bedtime.

Pelvic floor exercises (Kegel exercises): Pelvic floor muscles hold the urinary bladder in and assist in peeing. Kegels involve tightening and then releasing the pelvic floor muscles to strengthen them.

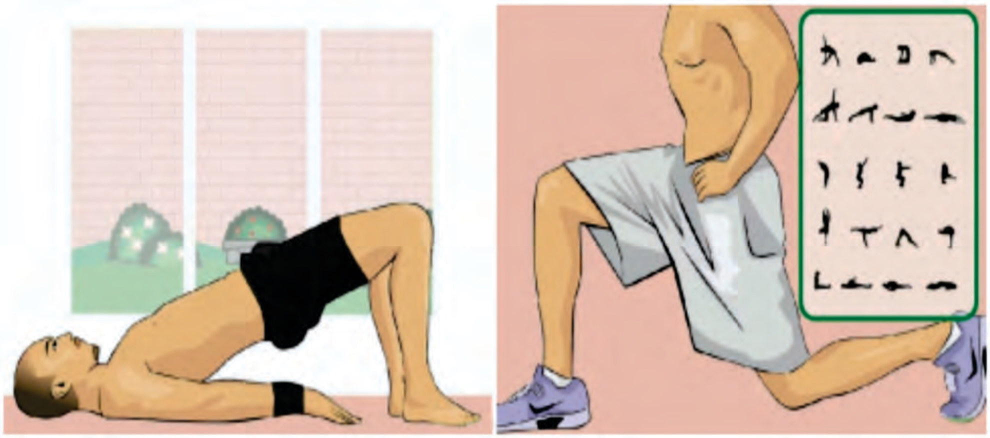

Figure 5.5: Kegel exercise

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Electrical stimulation therapy: Electrical stimulation of pelvic floor muscles increases their strength.

Sling surgery: Provides support to urethra and bladder, This support helps keep the urethra closed when pressure is exerted. So, patient does not leak urine.

Medications: Medicines are used to relax bladder muscles and to improve urine flow.

Figure 5.6: Electrical stimulation for pelvic floor muscles

5.3- KIDNEY DISEASES

Certain conditions can impair the functions of kidneys, leading to serious health problems. Two major kidney diseases are Acute Kidney Injury (AKI) and Chronic Kidney Disease (CKD). These conditions differ in and severity but can lead to life-threatening complications if not managed properly.

1- Acute Kidney Injury (AKI)

Acute Kidney Injury (AKI) is a sudden decline in kidney function over a short period. In AKI, the kidneys become unable to filter waste and fluids effectively.

> Skin can indicate kidney disease! Itching, dryness, and unusual skin colour changes can be signs of kidney dysfunction, as toxins build up in the body.

Causes of AKI

AKI can result from several conditions, including:

- **Dehydration or severe blood loss:** Reduced blood flow to the kidneys due to excessive vomiting, diarrhoea, or major injuries.
- **Infections and sepsis:** Severe infections can damage kidney tissues.
- **Toxic substances:** Certain medications (e.g., non-steroidal anti-inflammatory drugs, antibiotics) and poisons can harm kidneys.
- **Obstruction:** Blockage of urine flow due to kidney stones, tumors, or an enlarged prostate.

Symptoms of AKI

- Reduced urine output or sudden difficulty in urination.

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- Swelling in legs and face, nausea and vomiting.
- Fatigue and shortness of breath.

Complications of AKI

- Electrolyte imbalance and Fluid overload.
- Higher risk of infections due to weakened immunity.
- In severe cases, AKI can lead to long-term kidney damage.

2- Chronic Kidney Disease (CKD)

Chronic Kidney Disease (CKD) is a progressive loss of kidney function over months or years. Unlike AKI, CKD develops gradually and can lead to permanent kidney failure if untreated.

Diabetes is the leading cause of Chronic Kidney Disease (CKD).

Causes of CKD

- **Diabetes** (high blood sugar) damages kidneys.
- **High blood pressure** (hypertension) damages kidneys blood vessels.
- **Glomerulonephritis** (inflammation of the nephrons of kidneys).
- **Polycystic Kidney Disease (PKD):** A genetic disorder causing fluid-filled cysts in the kidneys.
- **Repeated kidney infections (Pyelonephritis):** Long-term infections weaken kidney function.

The functional units of the kidneys are called **nephrons**. There are more than one million nephrons in each kidney. A nephron consists of two parts i.e. renal corpuscle and renal tubule.

Symptoms of CKD

CKD often develops silently in the early stages, but symptoms appear as the disease progresses:

- Persistent fatigue and weakness.
- Swelling in the feet, ankles, and face.
- High blood pressure.
- Loss of appetite and nausea, frequent urination at night.

A single kidney can perform the function of two!
Many people live healthy lives with just one kidney, whether due to donation or medical conditions.

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Complications of CKD

- Anaemia i.e., decreased production of red blood cells.
- Weak bones due to imbalance of calcium and phosphorus.
- High risk of heart attack and stroke.
- Complete kidney failure i.e., End-Stage Renal Disease (ESRD).

> Kidneys can lose up to 90% of their function before symptoms appear!
>
> This is why kidney disease is often called a "silent killer." Regular checkups are crucial for early detection.

5.4 TREATMENT OF KIDNEY FAILURE

a. Dialysis

Dialysis is a method of cleaning the blood using an artificial process. In this method, blood and dialysis fluid are placed on opposite sides of a membrane. Waste passes from the blood through the membrane into the dialysis fluid. In this way, the blood is purified. There are two methods of dialysis.

1. Peritoneal Dialysis

In abdomen, the space around the gut is called peritoneal cavity. The walls of peritoneal cavity are lined with **peritoneal membrane** that contains a large number of blood vessels. In this method, **dialysis fluid** is pumped into the peritoneal cavity.

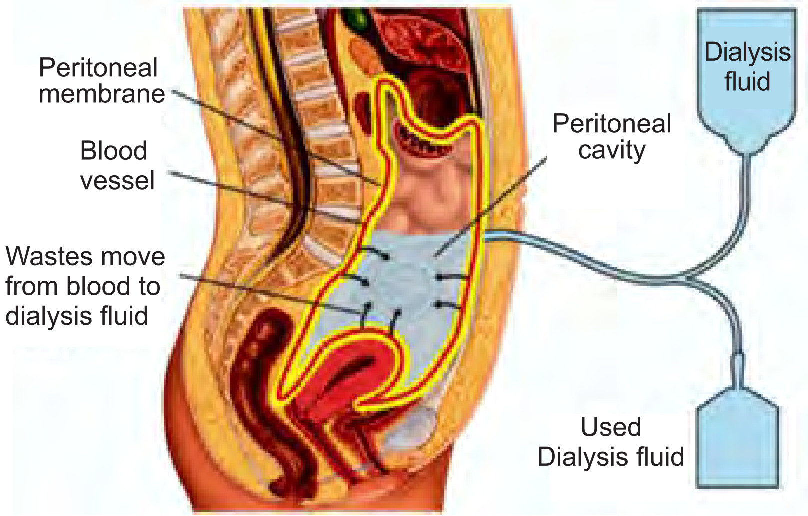

Figure 5.7: Peritoneal Dialysis

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The waste materials pass from the blood present in blood vessels of peritoneal membrane into the dialysis fluid. After some time, the dialysis fluid is drained. This form of dialysis is done daily and can be done at home.

2. Haemodialysis

In haemodialysis, the patient's blood is pumped through a machine called **dialyzer**. The dialyzer contains long tubes, lined with semi-permeable membranes. Blood flows inside the tubes while dialysis fluid flows outside. Wastes and extra water pass from the blood into the dialysis fluid. The clean blood is then returned to the body. Haemodialysis is done three times a week at a dialysis centre.

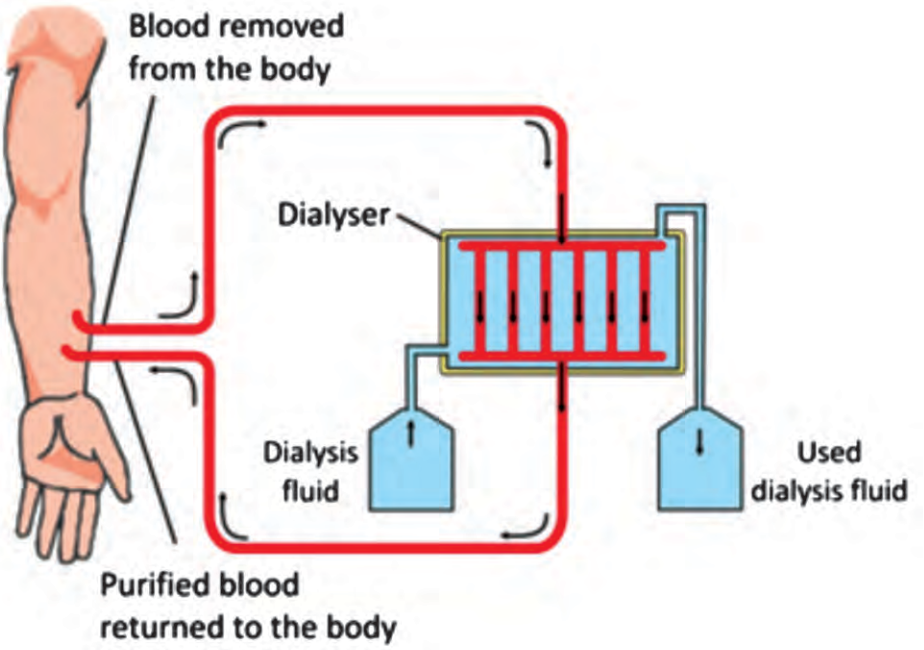

Figure 5.8: Haemodialysis

b. Kidney Transplantation

It is an advanced treatment for kidney failure. A healthy kidney from a donor is placed into the patient's body, along with the damaged kidney. The donor's kidney must match the patient's immune system. Once transplanted, the new kidney can work normally for **10 to 15 years**.

> In Punjab, organ transplantation is controlled by **Punjab Human Organ Transplant Authority**. It ensures that people can have suitable transplantation with safety and quality.

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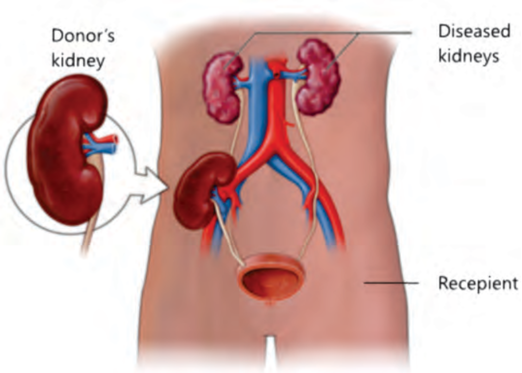

The Punjab Kidney and Liver Institute and Research Center (PKLI&RC) was established in Lahore in 2017. It is specialised healthcare facility that provides services for kidney and liver diseases, including kidney and liver transplants, dialysis, and gastroenterology.

5.5- DIAGNOSTIC TESTS FOR DISEASES OF URINARY SYSTEM

Early and accurate diagnosis is essential for detecting and managing diseases of the urinary system. The most common tests include urinalysis, blood tests, and imaging techniques.

> Diagnostic tests play a critical role in the early detection and management of urinary system diseases. These tests guide effective treatment. Timely diagnosis helps prevent complications and ensures better health management.

1. Urinalysis

Urinalysis is a simple test used to analyse the physical, chemical, and microscopic properties of urine.

Principles of Urinalysis

Physical Examination: Evaluates the colour, clarity, and odour of urine. For example, cloudy or foul-smelling urine may indicate an infection.

Chemical Analysis: Detects abnormal substances such as:

- **Proteins:** May indicate kidney disease.

> Urine colour can indicate hydration levels. – Light yellow urine means you're well-hydrated, while dark yellow or amber urine may indicate dehydration.

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- **Blood:** Could be a sign of infection or kidney stones.
- **Glucose and Ketones:** High glucose levels in urine suggest diabetes, while ketones indicate uncontrolled diabetes or starvation.
- **Nitrites and enzyme Leukocyte Esterase:** Presence of these substances suggests a UTI.

Microscopic Examination: Identifies bacteria, white blood cells, red blood cells, and crystals. For instance, presence of bacteria suggests an infection, while crystals may indicate kidney stones.

Uses of Urinalysis

- Detecting UTIs and kidney diseases.
- Diagnosing diabetes by identifying glucose and ketones in urine.
- Monitoring kidney health in patients with hypertension or diabetes.

2. Blood Tests

Blood tests provide vital information about kidney function and overall metabolic health.

> Kidney disease increases the risk of heart disease.
> Poor kidney function leads to fluid overload and high blood pressure, straining the heart.

Principles of Blood Tests

Serum Creatinine Test: Measures creatinine (a waste product from muscle metabolism). Elevated creatinine levels indicate impaired kidney function.

Blood Urea Nitrogen (BUN) Test: Measures the amount of nitrogen in the blood from urea. High urea levels suggest kidney dysfunction or dehydration.

Glomerular Filtration Rate (GFR): Estimates how well the kidneys are filtering blood. A low GFR is a sign of chronic kidney disease (CKD).

Blood Glucose and HbA1c Tests: Help to diagnose and monitor diabetes, which is a leading cause of kidney disease.

Uses of Blood Tests

- To detect AKI and CKD.
- To identify diabetes-related kidney problems.

> Some medicines can harm kidney function.
>
> Overuse of painkillers like ibuprofen and certain antibiotics can cause kidney damage over time.

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- To monitor kidney function in people with hypertension diabetes, and other disorders.

3. Imaging Techniques

Imaging techniques provide visual information about the structure of the kidneys, bladder, and urinary tract. These techniques help to detect blockages, stones, and anatomical abnormalities.

Principles of Imaging Techniques

Ultrasound (Sonography): Uses sound waves to create images of the kidneys and bladder. It helps detect kidney stones, cysts, and tumors.

Figure 5.10: Ultrasound procedure and results of kidney ultrasound

X-ray (KUB – Kidneys, Ureters, and Bladder): An X-ray machine passes electromagnetic radiation through the body and captures images of internal structures. KUB X-ray detects large kidney stones or structural abnormalities.

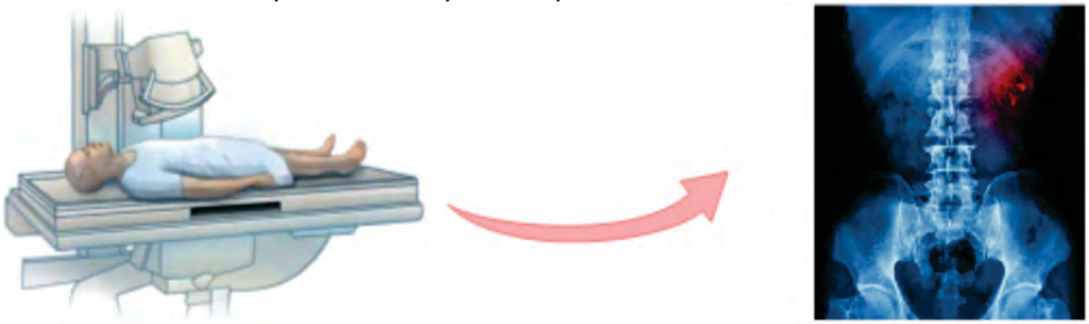

Figure 5.11: X-ray procedure and results of KUB X-ray

CT (Computed Tomography) Scan: Produces detailed cross-sectional images using X-rays and computer technology. It is useful for identifying small kidney stones and tumors etc.

> CT scan uses contrast dye to highlight kidney structures and detect tumors, stones, or blood flow issues.

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MRI (Magnetic Resonance Imaging): Uses magnetic fields and radio waves to create high-resolution images of soft tissues. It helps to diagnose complex kidney conditions and cystic diseases.

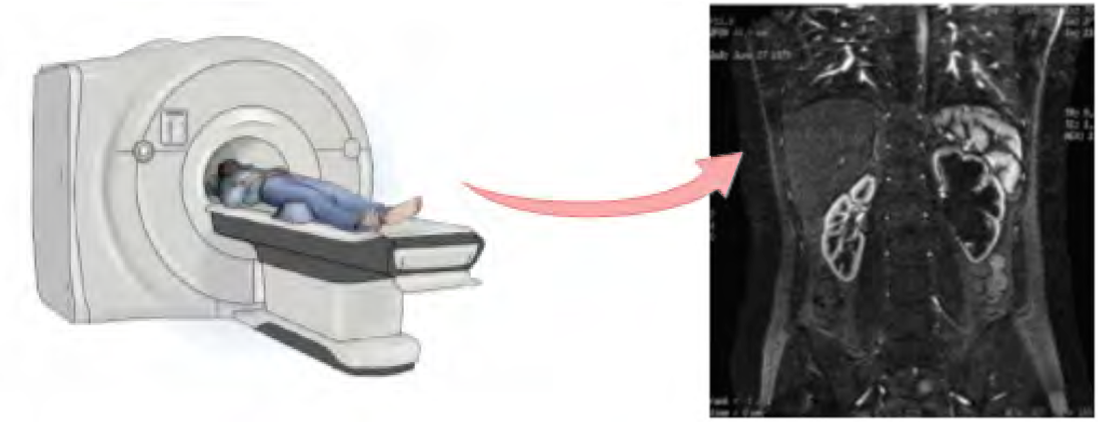

Figure 5.13: MRI procedure and MRI results showing both kidneys

Uses of Imaging Techniques

- To diagnose urinary obstructions, kidney stones, and tumors.
- To detect diabetic nephropathy, a kidney disease caused by diabetes.
- To monitor structural abnormalities such as polycystic kidney disease.

5.6 INTERPRETING LAB RESULTS FOR KIDNEY FUNCTION

1. Serum Creatinine

The kidneys filter the waste product creatinine out of the blood and excrete it in urine. Elevated level of creatinine in blood serum indicates impaired kidney function, as the kidneys fail to remove this waste efficiently.

Since creatinine is a waste product from muscle metabolism, athletes have slightly higher creatinine levels.

Conditions like malnutrition, muscle atrophy, or liver disease can cause unusually low serum creatinine levels.

Increased blood volume and enhanced kidney function during pregnancy may also lead to lower-than-normal creatinine levels.

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Interpreting Serum Creatinine Levels

Serum Creatinine (mg/dL)	Interpretation
0.6 – 1.2 (Normal range)	Healthy kidney function
1.3 – 1.9	Mild kidney dysfunction
≥ 2.0	Possible kidney disease, requires further testing
≥ 4.0	Severe kidney impairment, urgent medical attention needed

Example: If a patient's serum creatinine is **3 mg/dL**, it means that his kidneys are not filtering waste effectively. It may indicate acute AKI or CKD.

2. Glomerular Filtration Rate (GFR

The **glomerular filtration rate (GFR)** measures how efficiently the kidneys filter waste from the blood. A lower GFR indicates reduced kidney function and an increased risk of kidney disease progression.

Interpreting GFR Values

GFR (mL/min/1.73m^2)	Kidney Function	Stage of CKD
≥ 90	Normal function	No CKD
60 – 89	Mildly reduced function	Stage 1
30 – 59	Moderately reduced function	Stage 2
15 – 29	Severely reduced function	Stage 3
< 15	Kidney failure	Stage 4 (End-stage)

Example: If a patient's GFR is **45 mL/min**, it means **moderate kidney dysfunction (Stage 2 CKD)**, and he may require lifestyle modifications and medical intervention to prevent further decline.

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3. Blood Urea Nitrogen (BUN

This test measures the amount of nitrogen in the blood from urea, a waste product formed when the body breaks down proteins.

Interpreting BUN Levels

BUN Level (mg/dL)	Interpretation
7 – 20 (Normal range)	Normal kidney function
> 20	Possible kidney dysfunction or dehydration
> 50	Severe kidney impairment

Example: If a patient's **BUN level is 35 mg/dL**, it could indicate **kidney dysfunction** or dehydration, requiring further testing to confirm the cause.

EXERCISE

A. Select the correct answers for the following questions.

1. The kidneys play a role in maintaining homeostasis. They regulate:
   a) The levels of glucose in the blood
   b) The concentration of waste products, water, and salts
   c) The production of white blood cells in response to infections
   d) The breakdown of fats for energy
2. Which bacteria is the most common cause of UTIs?
   a) Streptococcus pneumoniae b) Escherichia coli (E. coli)
   c) Mycobacterium tuberculosis d) Salmonella typhi
3. Which of these is a UTI of kidneys?
   a) Urethritis b) Cystitis c) Pyelonephritis d) Nephritis
4. What is the purpose of lithotripsy in kidney stone treatment?
   a) Breaks stones b) Removes stones surgically
   c) Dissolves stones with drugs d) Prevents new stones
5. Which lab test helps to diagnose Chronic Kidney Disease (CKD)?
   a) Blood glucose test b) Serum creatinine test
   c) Liver function test d) Haemoglobin test

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6. What is the main characteristic of Acute Kidney Injury (AKI)?
   a) Sudden kidney damage
   b) Gradual kidney failure
   c) Permanent kidney loss
   d) Infection-related damage
7. Which of the following is a key difference between AKI and CKD?
   a) AKI is slow, CKD is sudden
   b) AKI is permanent, CKD is reversible
   c) AKI is reversible, CKD is progressive
   d) AKI occurs only in elderly people
8. Which lab result is most commonly elevated in both AKI and CKD?
   a) Blood glucose
   b) Serum creatinine
   c) Platelet count
   d) Haemoglobin level
9. Which blood test is most useful for assessing kidney function?
   a) Haemoglobin test
   b) Liver enzyme test
   c) Serum creatinine test
   d) Cholesterol test
10. What is the normal range of serum creatinine in healthy adults?
   a) 0.1–0.3 mg/dL
   b) 0.5–1.2 mg/dL
   c) 2.0–3.5 mg/dL
   d) 4.0–5.5 mg/dL

B. Write short answers.

1. What is the main function of the urinary system?
2. Name two common symptoms of a urinary tract infection (UTI).
3. What is the most common cause of kidney stones?
4. What is the key difference between Acute Kidney Injury (AKI) and Chronic Kidney Disease (CKD)?
5. What is pyelonephritis, and how does it occur?
6. Why is urinalysis important in detecting urinary infections?

C. Write answers in detail.

1. Explain how the urinary system helps maintain homeostasis in the body.
2. What are kidney stones? Write a note on the treatments for kidney stones.

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3. Describe the transmission, symptoms, and prevention of pyelonephritis, cystitis, and urethritis.
4. What is urinalysis? What abnormalities in urine indicate diseases?
5. Explain the significance of blood tests like serum creatinine and GFR in diagnosing kidney function.

Group Activities

1. Label a diagram of the urinary system.
2. Create a flowchart showing the progression and management of chronic kidney disease.
3. Develop a public health poster on preventing UTIs.
4. Role-play a patient consultation to explain the purpose of a diagnostic test like a kidney ultrasound.

Practical Activities

1. Develop a model to demonstrate the process of kidney filtration.
2. Perform an experiment to observe salt crystallization as a simulation of kidney stone formation.

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Chapter 6

FIRST AID - I

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Define first aid and explain its basic principles (e.g., DRABC: Danger, Response, Airway, Breathing, Circulation).
- Explain the signs of cardiac arrest and the importance of early CPR.
- Briefly describe the types of wounds (e.g., abrasions, lacerations, punctures).
- Describe the steps to control bleeding (e.g., direct pressure, elevation, pressure points).
- Explain the difference between fractures, sprains, and strains and their first aid management.
- Describe the first aid treatment for burns and scalds (e.g., cooling, covering, pain management).
- Identify the public agencies that provide first aid.
- Demonstrate the ability to assess an emergency scene for safety.

6.1 INTRODUCTION TO FIRST AID

First aid is the immediate care given to an injured or ill person before professional medical help arrives. It aims to preserve life.

Basic Principles of First Aid

First aid follows a structured approach known as **DRABC**:

D – Danger: Always check for potential hazards, such as fire, gas leaks, or oncoming traffic, before approaching a victim.

R – Response: Assess whether the person is conscious by speaking to them or gently tapping their shoulders. If they do not respond, they may need urgent medical help. If they are conscious, talk to them calmly to understand their condition and reassure them while help is on the way.

A – Airway: Check if the person's airway is blocked by foreign objects, fluids, or the tongue. A clear airway is vital for breathing. If the person is unconscious, tilting their head slightly backward can help keep the airway open.

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DRABC Steps for Primary Survey

Step 1 Danger

- Assess the Situation: Look for hazards.
- Ensure Safety: Make the area safe.
- Approach Safely: If safe help; if not call for help.

Step 2 Response

- Check Responsiveness: Talk or tap gently.
- Address Issues: Help if responsive; call for help if needed.

Step 3 Airway

- Assess the Situation: Look for hazards.
- Ensure Safety: Make the area safe.
- Approach Safely: If safe help; if not call for help.

Step 4 Breathing

- **Unconscious Victim:**
  - Tilt head, lift chin.
  - Check and clear the airway.
- **Responsive Victim:**
  - Look for obstructions.
  - Assist if needed; avoid fingers in the mouth.

Step 5 Circulation

- Check Respiration: Observe, listen, feel.
- Ensure Regular Breathing: Confirm for 10 seconds.
- Emergency: Unresponsive and not breathing regularly? Call for help; do CPR if trained.

B – Breathing: Look, listen, and feel for normal breathing. If the person is not breathing or breathing abnormally, immediate intervention is necessary. Without oxygen, permanent brain damage can occur within minutes, making quick action essential.

C – Circulation: Check for a pulse and other signs of circulation. If absent, start chest compressions immediately to maintain oxygen supply to vital organs.

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6.2 BASIC LIFE SUPPORT (BLS) AND CPR

Basic Life Support (BLS) is an emergency medical procedure. It is used to sustain life in cases of cardiac arrest, respiratory distress, or airway obstruction. It includes CPR (Cardiopulmonary Resuscitation) and airway management.

CARDIO PULMONARY RESUSCITATION (CPR)

CPR is a life-saving technique used when a person's breathing or heartbeat has stopped. CPR is essential in cases of cardiac arrest, drowning, or severe choking.

Golden Hour Rule: The first 60 minutes after an injury are the most crucial for survival and recovery. Providing proper first aid within this period can significantly reduce complications.

1. Recognizing Signs of Cardiac Arrest

A person experiencing cardiac arrest may exhibit the following signs and symptoms:

Sign	Symptom
Sudden collapse	Chest pain
Unresponsiveness	Dizziness or lightheadedness
No pulse or heartbeat	Weak or irregular pulse
No breathing	Sudden fatigue
Bluish skin (cyanosis)	
Dilated pupils	

2. Performing CPR (for adults)

It involves chest compressions and rescue breaths to circulate oxygenated blood to the brain and other vital organs.

Steps for CPR (for adults)

- Ensure the scene is safe and that no hazards are present.
- Tap the person and shout to check responsiveness.
- Call emergency services (e.g., Rescue 1122 in Pakistan) for help.

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- Chest Compressions: Begin chest compressions by placing hands in the centre of the chest and pushing hard and fast. Give compressions at a depth of at least 2 inches for adults, at a rate of 100-120 per minute.
- Rescue Breaths: Give 2 breaths after every 30 compressions.
- Continue until help arrives or the person recovers.

Figure 6.2: CPR steps

Airway Management

Airway management refers to the process of ensuring that a person's airway remains open and unobstructed, allowing for proper breathing. In first aid, airway management is a priority because a blocked airway can quickly lead to deficiency of oxygen, brain damage, or even death.

Basic Techniques for Airway Management in First Aid

- **Head-Tilt Chin-Lift Maneuver**: Used to open the airway of an unconscious person. It is done by tilting the head back and lifting the chin forward to prevent the tongue from blocking airflow.

Choking First Aid: If alone and choking, one can perform the self-Heimlich maneuver by leaning over a chair or countertop and thrusting the abdomen forcefully against the edge.

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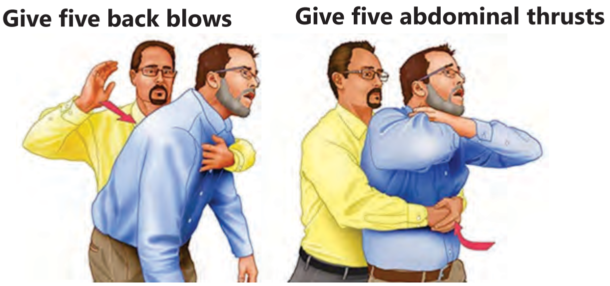
- **Jaw-Thrust Maneuver**: Used in cases of suspected spinal injuries, where the head should not be tilted. Instead, the lower jaw is pushed forward to open the airway.
- **Recovery Position**: If a person is unconscious but breathing, he is placed on his side. It prevents airway obstruction from the tongue or vomit.
- **Heimlich Maneuver (Abdominal Thrusts):** Used for choking individuals to expel a foreign object from the throat.



(A)

(B)

Figure 6.3: (A) Choking First Aid (Heimlich maneuver): (B) Head-Tilt Chin-Lift maneuver

6.3 WOUNDS AND BLEEDING

Wound and its Types

An injury to living tissue caused by a cut, blow, or other impact is called wound. These are the main types of wounds and their treatment.

<table>
<tr><th>Wound Type</th><th>First Aid Treatment</th></tr>
<tr><td>Abrasion: It is a minor skin injury caused by friction, such as scraping the knee on rough surfaces.</td><td>• Clean the area with a saline solution or water.
• Cover it with a sterile dressing.</td></tr>
<tr><td>Incision: This is a wound resulting from an incident with a sharp-edged object like a knife, a razor, or a piece of glass.</td><td rowspan="2">• Sit or lay down, apply direct pressure to the wound for 10 mins.
• Cover it with a sterile dressing. Refer to clinic or hospital for stitching the wound.</td></tr>
<tr><td>Laceration: It is also a deep cut caused by sharp object. It is similar to incision but has an irregular break in the skin.</td></tr>
</table>

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Puncture: It occurs when pointed objects, such as nails or needles, penetrate the skin.	• Call RESCUE 1122 for emergency assistance. • Control bleeding with minimum movement of the affected area. This can be done by applying pressure to either side of the puncture wound. • Never remove the object by yourself – This could result in further internal damage.

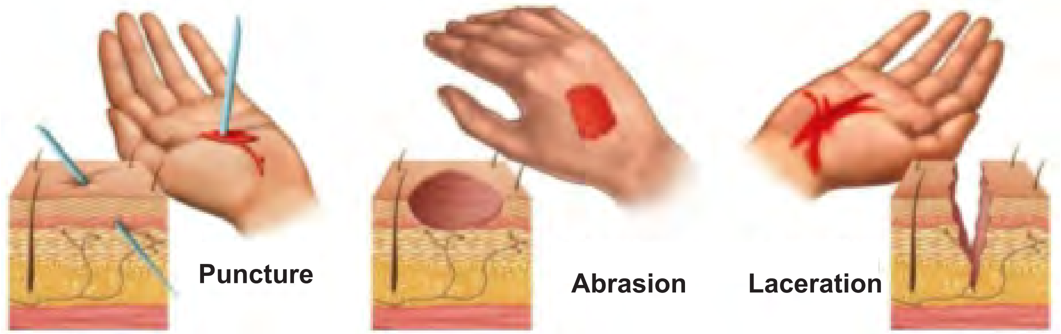

Figure 6.4: Major types of wound

- **Burn wound:** It is tissue damage caused by heat, chemicals, electricity or radiation.

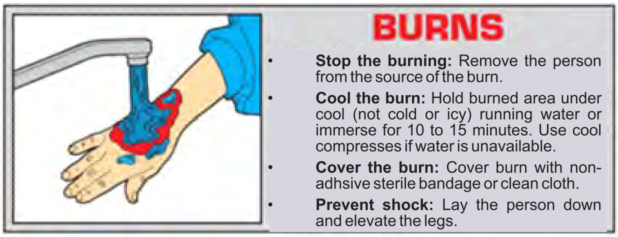

Figure 6.5: Burn management

Bleeding

It is a loss of blood when you get a cut or wound.

Steps to Control Bleeding

- Direct pressure: Firmly press a clean cloth against the wound to slow or stop bleeding.
- Elevation: Raise the injured limb above heart level. It can reduce blood

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flow and minimize bleeding.

- Pressure points: If direct pressure and elevation are ineffective, Apply pressure to major arteries near wounds.
- Dress the wound: Cover the wound with a sterile bandage. It helps prevent infection and promotes healing.

Figure 6.6: Management of bleeding

> **Blood Loss Warning:** The average adult has around 5 liters of blood. Loss of just 1.5 liter blood quickly can lead to shock. It means bleeding control should be an urgent priority.

6.4 FRACTURES, SPRAINS AND STRAINS

Fractures

A fracture is a break in a bone caused by trauma.

First Aid Steps

- Keep the person still.
- Immobilize the area.
- Apply cold therapy.
- Control bleeding (if open fracture) by covering the wound with a clean cloth and apply gentle pressure.
- Seek medical help immediately and transport the person to hospital.

Figure 6.7: Management of bleeding

Important Caution: Do not move the person if a spinal fracture is suspected.

Sprains and Strains

A **sprain** occurs when ligaments (tissues which connect bone to bone) are stretched or torn due to sudden twisting or pressure. A **strain** is an injury to a muscle or tendon (tissue which connect bone to muscle).

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First Aid Steps (R.I.C.E Method)

- **R**est – Avoid using the injured area to prevent further damage.
- **I**ce – Apply an ice pack wrapped in a cloth for 15-20 minutes every 2-3 hours to reduce swelling and pain.
- **C**ompression – Wrap the injured area with an elastic bandage.
- **E**levation- of the injured limb.

Figure 6.8: Management of Sprains

6.5 DEPARTMENTS/ORGANIZATIONS PROVIDING FIRST AID

In Punjab, there are several public agencies and organizations that provide first aid services. Some of the key agencies include:

- **Rescue 1122:** Rescue 1122 is Punjab's emergency service that provides emergency medical services, including first aid, ambulance services, and disaster management.
- **Pakistan Red Crescent Society:** The Pakistan Red Crescent Society is the local affiliate of the International Red Cross. It provides first aid training, emergency medical response, and disaster relief services.
- **EDHI Foundation:** The EDHI Foundation is a social welfare organization. It provides emergency services, including first aid and ambulance services, throughout Pakistan.
- **Community-Based Organizations:** Several community-based organizations also offer first aid training and provide emergency response services.

Figure 6.9: Main First Aid Service Providers in Punjab

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EXERCISE

A. Select the correct answers for the following questions.

1. What does the "D" in DRABC stand for?

   a) Diagnosis b) Danger
   c) Delivery d) Duration

2. Which of the following is NOT a sign of cardiac arrest?

   a) Sudden collapse b) Chest pain
   c) Bluish skin d) Dizziness

3. What is the first step in CPR for an adult?

   a) Start chest compressions b) Call emergency services
   c) Open the airway d) Provide rescue breaths

4. What is the correct compression depth for CPR on an adult?

   a) 1 inch b) 2 inches
   c) 3 inches d) 4 inches

5. Which type of wound is caused by friction?

   a) Laceration b) Puncture
   c) Abrasion d) Incision

6. Which method is used for a suspected muscle or tendon injury?

   a) R.I.C.E b) A.B.C
   c) D.R.A d) I.C.E

7. Which of these agencies provides first aid services in Punjab?

   a) Rescue 1122 b) Edhi Foundation
   c) Pakistan Red Crescent d) All of the above

8. What should you do if you find a person with a suspected spinal fracture?

   a) Move them to a safe place
   b) Immobilize the person and call for help
   c) Apply cold therapy
   d) Encourage movement

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B. Write short answers.

1. What does the DRABC approach stand for in first aid?
2. What are the signs of cardiac arrest?
3. How should you perform chest compressions during CPR?
4. What is the primary first aid for a person suffering from burns?
5. What is the R.I.C.E method for sprain management?

C. Write answers in detail.

1. Explain the DRABC approach in first aid and its significance in saving lives.
2. Describe the steps and techniques involved in performing CPR on an adult.
3. Discuss the different types of wounds and their appropriate first aid management.
4. Explain the differences between fractures, sprains, and strains. Discuss their first aid management.

Group Activities

1. Your school will manage the demonstration of first aid by Rescue 1122. After attending these demonstrations, role play for demonstrating first aid in different emergency situations.
2. Create a response plan for emergencies at school, home or public places.
3. Simulate the ability to assess an emergency scene for safety.

Practical Activities

1. Perform chest compressions and rescue breaths under supervision on a mannequin.
2. Simulate bleeding wound dressing using fake wounds or red-coloured liquid.
3. Illustrate proper burn treatment, including cooling, covering, and avoiding incorrect methods.

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Chapter 7

PHYSICAL EDUCATION

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Define physical education and explain its role in maintaining physical and mental well-being.
- Explain how exercise improves cardiovascular health, muscle strength, and mental health.
- Describe the first aid management of sports injuries (e.g., sprains, strains, fractures) using the RICE method (Rest, Ice, Compression, Elevation).
- Describe the risks of overexertion and sudden cardiac events during physical activity.
- Explain how exercise contributes to weight management and metabolic health.
- Describe the risks of poor posture and improper techniques during exercise.
- Develop a simple exercise routine for improving overall fitness.
- Justify the proper posture and techniques for common exercises.

7.1 INTRODUCTION TO PHYSICAL EDUCATION

Physical Education (PE) is the education through physical activities for the development of total personality of a person. In PE, the educational aims are achieved by means of sports, games, gymnastic, and exercise. It helps students develop motor skills, coordination, and lifelong healthy habits, discipline and leadership.

Benefits of Regular Exercise

Doing regular physical activity or exercise has a wide range of benefits. These benefits are beyond improving physical appearance. The positive effects of exercise can be categorized into physical, mental, emotional, and social benefits.

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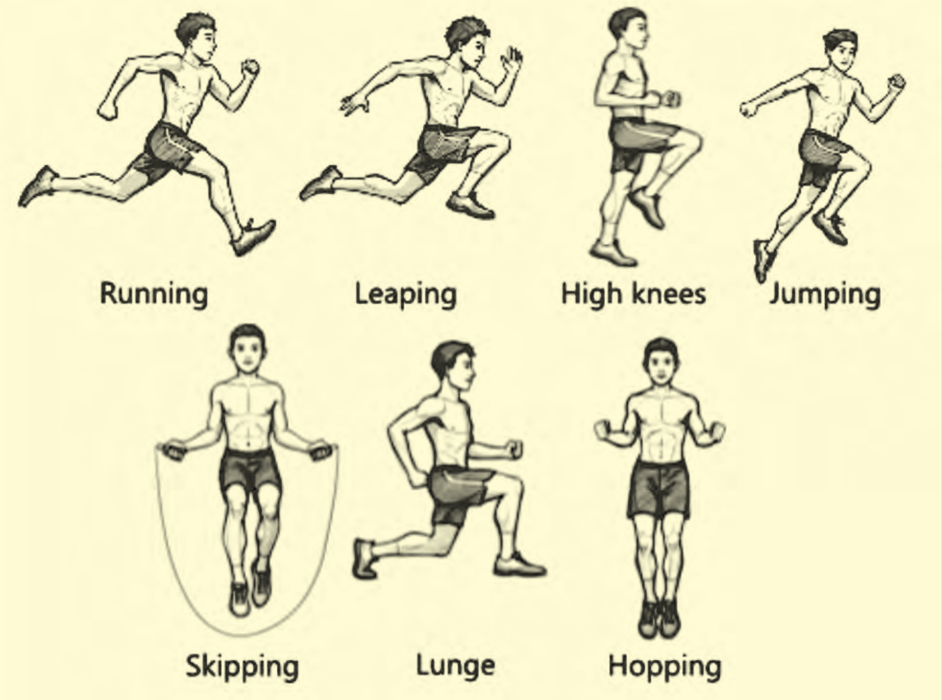

Figure 7.1: Physical exercises

Physical Benefits:

- Strengthens muscles and bones
- Improves cardiovascular health by enhancing heart function and circulation.
- Helps control body weight.
- Boosts immunity, making the body more resistant to infections and illnesses.
- Increases lung capacity, improving endurance and stamina for daily activities.
- Enhances flexibility, coordination, and balance, reducing the risk of falls and injuries.
- Regulates blood sugar levels, decreasing the risk of type 2 diabetes and metabolic disorders.

> Did you know that 10 minutes of jumping jacks can burn up to 100 calories? That's about the same as running a mile!

Mental and Emotional Benefits:

- Reduces stress, anxiety, and depression.
- Enhances cognitive function, improving focus, memory, and learning abilities.

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- Builds self-confidence and promotes a positive self-image by improving posture.
- Helps regulate sleep patterns, leading to better rest and overall well-being.
- Encourages discipline and time management through structured exercise routines.

> Sitting for over 8 hours a day is as harmful to health as smoking, increasing the risk of obesity, diabetes, and heart disease.

- Increases energy levels, making daily tasks easier and more enjoyable.

7.2 EXERCISE AND CARDIOVASCULAR HEALTH

The heart is a muscle that benefits greatly from regular exercise. A healthy heart ensures an adequate supply of oxygen and nutrients to the body's tissues, reducing the risk of cardiovascular diseases.

Benefits of Exercise for the Heart

- Reduces the risk of heart disease, high blood pressure and stroke.
- Increases blood circulation and oxygen supply to organs.
- Lowers bad cholesterol (LDL) and increases good cholesterol (HDL).
- Helps regulate blood sugar levels, reducing the risk of diabetes.
- Improves heart efficiency.

Benefits of Exercise for the Muscles

Exercise provides numerous benefits for muscles. For example:

- Increases strength and size of muscles..
- Builds muscle stamina, allowing longer activity without fatigue.
- Improves range of motion and reduces stiffness.
- Enhances blood flow to the muscles.
- Improves muscles flexibility.

7.3 WEIGHT MANAGEMENT AND METABOLIC HEALTH

Exercise plays a significant role in weight management and metabolic health in several key ways:

1. Calorie Burn and Weight Loss

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- Regular physical activity helps prevent weight gain by balancing energy intake with expenditure.
- Strength training builds muscle, which burns more calories.

2. Regulate blood sugar level

- Regular exercise helps regulate blood sugar levels and can prevent or manage **type 2 diabetes.**

4. Fat Reduction and Body Composition:

- **Aerobic exercise** (like walking, running, or cycling) helps reduce body fat, improving body composition (more muscle, less fat).

5. Appetite Regulation

- Regular physical activity may help control **appetite**. It reduces cravings and promoting healthier eating habits.

7.4 SPORTS INJURIES AND FIRST AID MANAGEMENT

Physical activity, while beneficial, also comes with the risk of injury. Understanding common sports injuries and their first aid management is crucial in preventing long-term complications.

Types of Sports Injuries

- **Sprains:** Overstretching or tearing of ligaments, often affecting the ankles, knees, or wrists.
- **Strains:** Injury to muscles or tendons due to excessive stretching. Commonly occurring in the back, shoulders, and legs.
- **Fractures:** Broken bones caused by high-impact collisions, falls, or excessive stress on a bone over time (stress fractures).
- **Dislocations:** Joints forced out of their normal position due to sudden impact.

Figure 7.2: Sports injuries

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First Aid Management (R.I.C.E Method)

- **Rest:** Avoid using the injured area to prevent further damage and promote healing.
- **Ice:** Apply an ice pack to reduce swelling and numb pain, using 15-minute intervals.
- **Compression:** Use a bandage to support the injured area and control swelling.
- **Elevation:** Keep the injured limb raised to reduce blood flow and swelling, aiding recovery.

In severe cases, medical assistance should be sought immediately. Wearing appropriate protective gear, warming up before activities, and using proper techniques can significantly reduce the risk of injuries.

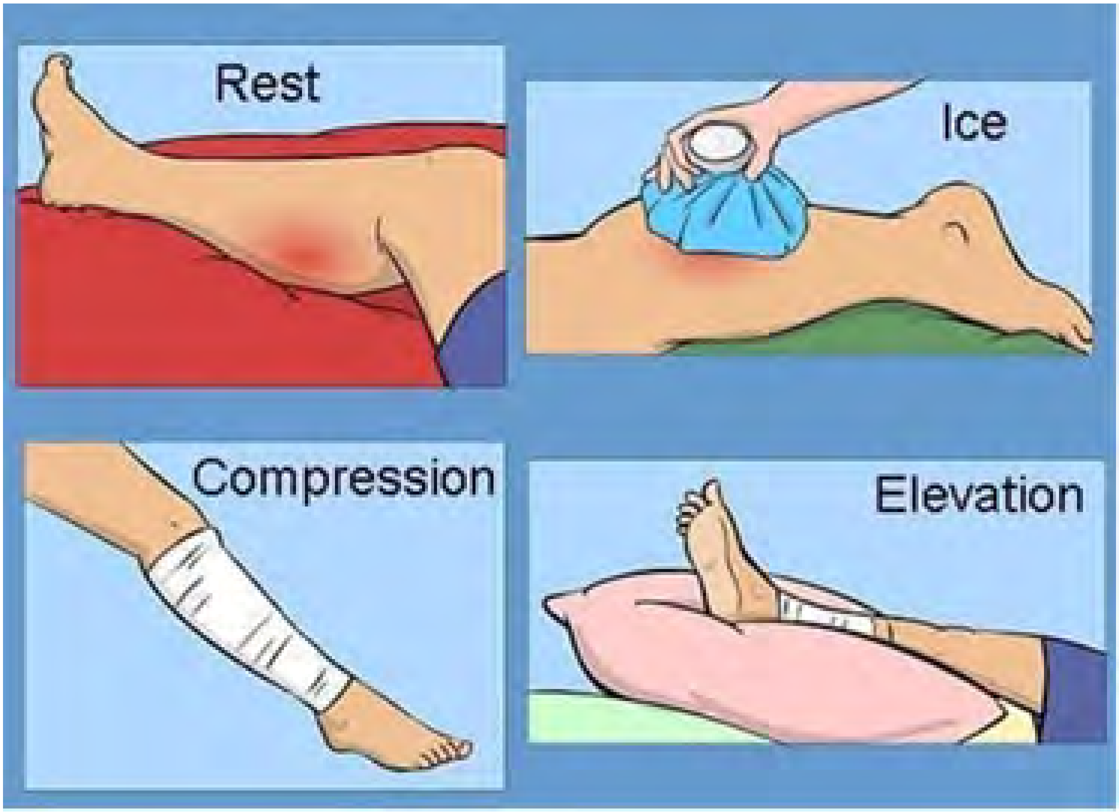

Figure 7.3: R.I.C.E method

7.5 KEY RISKS DURING PHYSICAL ACTIVITY

Overexertion and sudden cardiac events during physical activity can be dangerous.

1. Overexertion

- Pushing the body too hard can lead to muscle tears or strains, causing pain and limiting mobility.
- Overdoing it can lead to extreme tiredness, dizziness, and dehydration.
- Exercising in hot conditions without proper hydration can cause heat exhaustion or heat stroke, which can be life-threatening.
- High-intensity exercise without adequate warm-up can result in joint sprains, strains, or ligament injuries.

2. Sudden Cardiac Events

- Intense physical activity, especially in individuals with underlying heart conditions, can trigger a heart attack due to the increased demand on the heart.
- Overexertion can lead to irregular heart rhythms (arrhythmias), which may cause dizziness, fainting, or even sudden cardiac arrest in extreme cases.

Poor Posture and Improper Exercise

Poor posture and improper exercise can lead to a range of health risks, including:

1. Musculoskeletal Injuries

- **Strains and sprains**
- **Joint damage**
- **Herniated discs**

2. Chronic Pain and Postural Imbalances

- Incorrect posture while lifting weights during exercises strains the lumbar spine.
- Forward head posture and improper alignment can cause muscle tension and headaches.

Overuse of certain muscle groups without proper posture can lead to weakness and compensation by other muscles.

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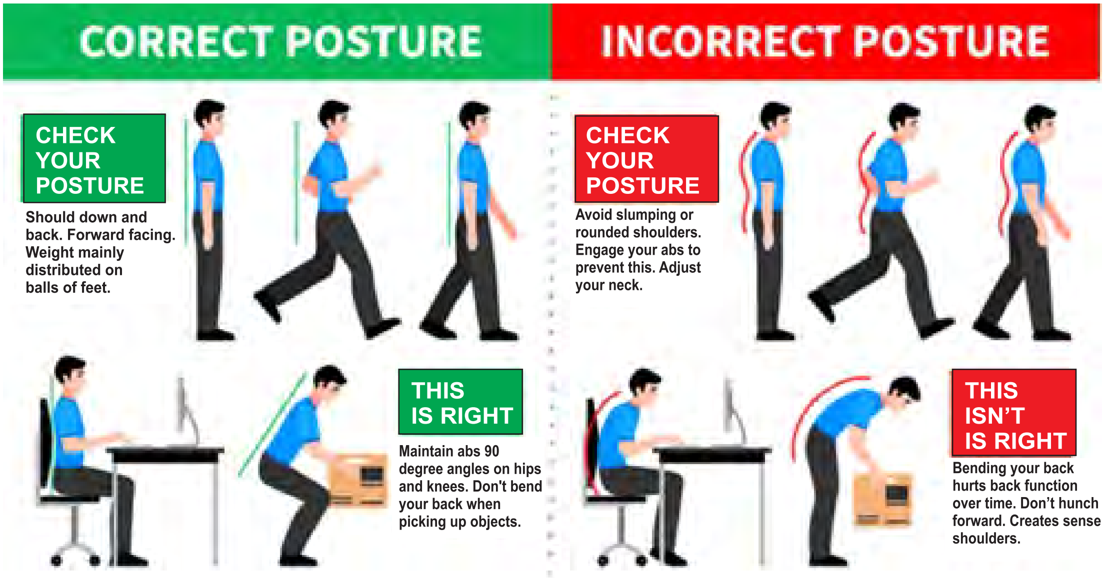

Figure 7.4 : Correct and incorrect Posture

4. Breathing and Circulatory Issues

- Poor posture can compress the chest, reducing oxygen intake.
- Improper positioning can restrict blood flow, increasing the risk of numbness and cramping.

5. Increased Risk of Falls and Accidents

- Poor posture affects stability, leading to a higher risk of falls, especially during dynamic movements.
- Improper technique while using gym equipment can result in accidents.

7.6 DEVELOPING EXERCISE ROUTINE

Exercise routine is designed to improve overall fitness and strength, flexibility, and cardiovascular endurance.

Warm-up (5-10 minutes)

1. **Jog in place** – 2 minutes
2. **Jumping jacks** – 1 minute
3. **Arm circles** – 30 seconds each direction (forward and backward)
4. **High knees** – 1 minute

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Jog in place | Jumping jacks | Arm circles | High knees

Figure 7.5: Warm-up exercises

Main Workout (20-30 minutes)

1. Bodyweight Squats

- **Repetitions**: 3 sets of 12-15 repetitions
- **Instructions**: Stand with feet shoulder-width apart, toes pointing slightly outward. Lower your hips back and down as if sitting into a chair, keeping your chest lifted and knees behind your toes. Push through your heels to return to standing.
- **Why it's good**: Builds lower body strength (legs, glutes, and core), and improves posture and balance.

2. Push-ups

- **Repetitions**: 3 sets of 8-12 repetitions
- **Instructions**: Start in a plank position, with hands directly under shoulders, body in a straight line from head to heels. Lower yourself toward the ground by bending your elbows, keeping your body rigid. Push back up.
- **Why it's good**: Strengthens the upper body (chest, shoulders, arms) and core.

3. Planks

- **Hold**: 30-60 seconds (3 sets)
- **Instructions**: Lie face down and prop your body up on your elbows and toes. Keep your body in a straight line, tightening your core, and avoid letting your hips drop or rise.
- **Why it's good**: Strengthens core, back, and shoulders.

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4. Walking Lunges

- **Repetitions**: 3 sets of 10-12 steps per leg
- **Instructions**: Step forward with one leg, lowering your hips until both knees are bent at 90 degrees. Push through the front heel to bring the back leg forward to repeat. Keep your chest up and avoid leaning forward.
- **Why it's good**: Improves lower body strength, balance, and coordination.

5. Mountain Climbers

- **Repetitions**: 3 sets of 30 seconds
- **Instructions**: Start in a plank position, then alternate bringing knees toward your chest as if "climbing." Keep your body straight and move quickly, ensuring you don't let your back sag.
- **Why it's good**: Boosts cardiovascular fitness while strengthening the core and legs.

6. Bicycle Crunches

- **Repetitions**: 3 sets of 15-20 repetitions per side
- **Instructions**: Lie on your back, lift your legs, and alternate bringing your elbows toward the opposite knee while straightening the other leg. Keep your lower back pressed into the ground.
- **Why it's good**: Engages the core, especially the obliques (side ab muscles).

Figure 7.6: Main workout

Cool Down (5-10 minutes)

1. **Standing hamstring stretch** – 30 seconds per leg
2. **Quad stretch** – 30 seconds per leg
3. **Chest stretch** (using a wall or doorway) – 30 seconds per side
4. **Child's pose** (yoga stretch) – 1 minute
5. **Deep breathing** – Focus on slow, deep breaths for relaxation and recovery.

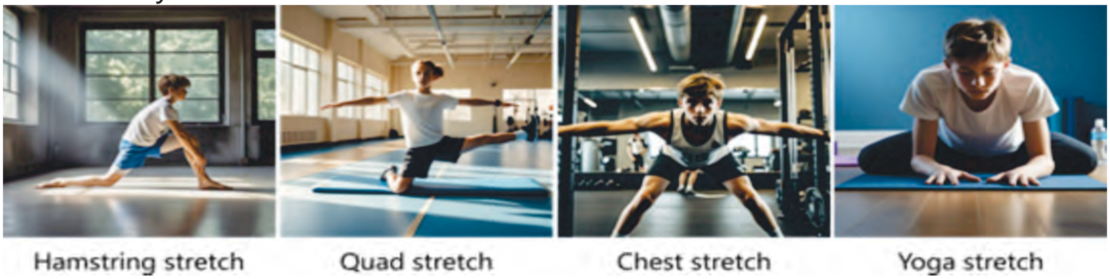

Figure 7.7: Cool down exercise

7.7 IMPORTANCE OF PROPER POSTURE & TECHNIQUES

1. Bodyweight Squats

- **Proper posture:** Keep your chest lifted, shoulders back, and your knees behind your toes to prevent strain on the joints. The weight should be on your heels, not on your toes, to maintain balance.
- **Importance:** Proper technique avoids knee injuries and ensures you're effectively working your leg muscles. By keeping your chest up, you protect your lower back from rounding.

2. Push-ups

- **Proper posture:** Keep your body in a straight line from head to heels. Don't allow your lower back to sag or your hips to rise.
- **Importance:** This ensures maximum muscle engagement (especially in the core and upper body) and prevents lower back strain.

3. Planks

- **Proper posture:** Engage your core, keep your back flat, and avoid letting your hips sag toward the ground.

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- **Importance:** This prevents strain on the lower back and ensures that you're targeting the core muscles effectively.

4. Walking Lunges

- **Proper posture:** Keep your chest up and back straight. Avoid letting the front knee go past your toes when you bend it.
- **Importance:** Proper technique prevents knee injuries and ensures that you're targeting the glutes and thighs.

5. Mountain Climbers

- **Proper posture:** Maintain a straight body, avoiding sagging hips. Ensure your shoulders are directly over your wrists to avoid wrist strain.
- **Importance:** Proper technique enhances the effectiveness of the movement for the core and legs and prevents wrist or shoulder injuries.

6. Bicycle Crunches

- **Proper posture:** Avoid pulling on your neck. Keep your elbows wide, and ensure that the movement comes from your core, not your arms.
- **Importance:** This avoids neck strain and ensures the abdominal muscles are engaged properly.

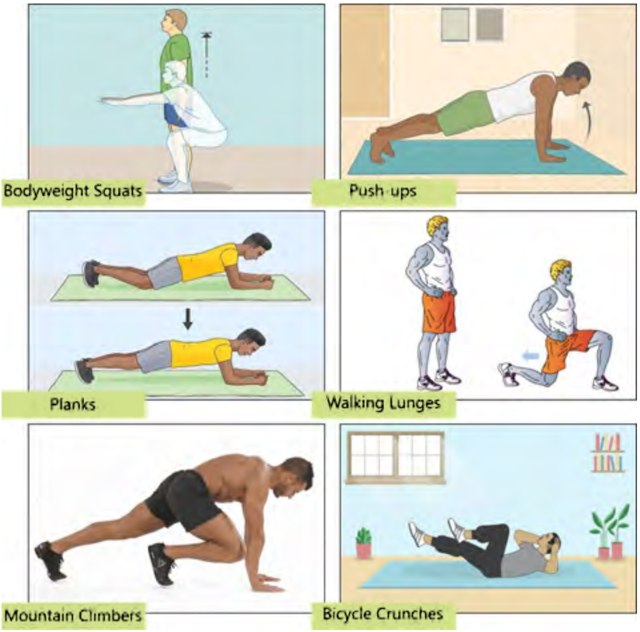

Figure 7.8: Proper postures and techniques for exercises

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EXERCISE

A. Select the correct answers for the following questions.

1. What is the primary purpose of Physical Education?
   a) To entertain students
   b) To promote physical fitness and health
   c) To teach academic subjects
   d) To prepare students for competitive sports
2. Which of the following is a benefit of regular exercise?
   a) Increased stress and anxiety
   b) Improved cardiovascular health
   c) Decreased muscle strength
   d) Poor posture
3. What does the "I" in the RICE method stand for?
   a) Ice b) Injury
   c) Intensity d) Ignition
4. Which exercise primarily strengthens the core?
   a) Squats b) Push-ups
   c) Plank d) Walking lunges
5. What does overexertion during physical activity increase the risk of?
   a) Better performance
   b) Heart attack and muscle strain
   c) Enhanced endurance
   d) Improved flexibility
6. What is one of the benefits of strength training?
   a) Decreases muscle size
   b) Increases endurance
   c) Reduces bone density
   d) Decreases flexibility
7. Which of the following can improve metabolic health?
   a) Regular exercise b) Poor diet
   c) Lack of sleep d) Sedentary lifestyle

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8. Why is maintaining proper posture important during exercises like squats?
   a) To increase speed
   b) To prevent strain on joints and muscles
   c) To reduce flexibility
   d) To improve muscle hypertrophy

9. What can poor posture during exercise lead to?
   a) Reduced risk of injuries
   b) Muscle imbalances and joint damage
   c) Faster recovery
   d) Improved heart health

10. Which of these exercises is recommended to improve lower body strength and balance?
   a) Push-ups
   b) Walking lunges
   c) Bicycle crunches
   d) Mountain climbers

B. Write Short Answer

1. What are the mental and emotional benefits of regular exercise?
2. List the risks associated with overexertion during physical activity.
3. How does exercise contribute to weight management?
4. What are the dangers of poor posture during exercise?
5. What are the benefits of muscle strength training?

C. Write answer in detail:

1. Discuss the physical, mental, and emotional benefits of regular exercise. How do these benefits contribute to an individual's overall well-being?
2. Explain the process of how exercise strengthens the heart and improves cardiovascular health
3. What is the significance of the RICE method in managing sports injuries? Provide a detailed explanation of each step involved.
4. What are the consequences of poor posture and improper techniques during exercise? How can these be avoided?

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Group Activities

1. Write a short essay on the importance of physical education in daily life.
2. Create a poster highlighting the benefits of regular exercise.
3. Perform a simulation of first aid for a sports injury.
4. Conduct a group discussion on the importance of exercise for heart health.
5. Create a presentation on the role of exercise in combating obesity.

Practical Activities

1. Measure and record the heart rate and respiratory rate (before and after exercise).
2. Demonstrate basic first aid techniques for treating a sprain or strain.
3. Conduct the common posture mistakes & correction activity.

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Chapter 8
NUTRITION

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Define macronutrients (proteins, carbohydrates, fats) and micronutrients (vitamins, minerals) and their roles in the body.
- Explain national and international dietary guidelines (e.g., food pyramids, MyPlate).
- Describe the causes, symptoms, consequences and prevention of undernutrition (e.g., stunting, wasting, anaemia) and overnutrition (e.g., obesity).
- Explain the symptoms, causes, and prevention of specific deficiencies of vitamins and iron.
- Identify the sources of macronutrients and micronutrients in common foods.
- Design a balanced meal plan for a day based on dietary guidelines.
- Identify dietary habits that contribute to chronic diseases and suggest improvements.

Nutrition is the foundation of good health. It provides the body with essential nutrients for growth, energy, and overall well-being. In this chapter, we will explore the importance of balanced nutrition, the consequences of malnutrition, and how diet plays a crucial role in preventing chronic diseases.

8.1 INTRODUCTION TO NUTRITION

Nutrition is the process by which living organisms obtain and utilize food for growth, energy production, and overall health. **Nutrients** are substances found in food that provide energy, support growth, and help maintain body functions. The human body requires a variety of nutrients to function properly. A balanced diet contains all necessary nutrients in the right amounts. Poor nutrition can lead to health problems such as weakness, slow growth, and various diseases.

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Types of Nutrients

Nutrients are divided into two main groups based on the quantity needed by the body:

Macronutrients – The nutrients which are required in large amounts are called macronutrients. They provide energy or structural components for the body. They include carbohydrates, proteins, and fats.

Micronutrients – These are needed in small amounts but are vital for various body functions. They include vitamins and minerals. Micronutrients help to regulate body processes.

Macronutrients and their Roles

Macronutrients serve as the main building blocks of the body and supply the energy needed for daily activities.

1. Carbohydrates

Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen that serve as the body's main energy source.

Role in the Body: Carbohydrates are broken down into glucose, which is used by the body for immediate energy. One gram of carbohydrates provides 04 kilocalories of energy. Extra glucose is stored in the liver and muscles as glycogen for later use.

Sources: Grains (rice, wheat, corn), bread, pasta, fruits, vegetables, and dairy products.

Figure 8.1: Sources of carbohydrates

2. Proteins

Proteins are large molecules made of amino acids.

Role in the Body: Proteins are essential for muscle development, enzyme production, hormone regulation, and immunity (defence against pathogens). They also aid in wound healing and cell repair.

Sources: Meat, fish, eggs, dairy, beans, nuts, and soy products.

Figure 8.2 Sources of proteins

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3. Fats / Lipids

Fats or lipids are energy-rich compounds made of fatty acids and glycerol.

Role in the Body: Fats provide long-term energy storage, protect organs, help absorb fat-soluble vitamins (A, D, E, K), and support brain function.

If there are more lipids in diet, fatty layer deposits in blood vessels. It can lead to heart disease. A diet high in lipids also results in obesity and diabetes.

One gram of fats contains 09 kilocalories of energy.

Sources: Nuts, seeds, fish, olive oil, butter, and dairy products.

Types:

Figure 8.3: Sources of Fat

- **Unsaturated fats** are healthy fats and found in nuts, seeds, fish, and plant oils.
- **Saturated fats** are found in animal products like butter and cheese. These fats should be consumed in moderation.
- **Trans fats** are unhealthy fats found in processed foods like fried items and bakery goods.

Micronutrients and their Roles

Micronutrients do not provide energy but are essential for proper growth, immunity, and body functions.

1. Vitamins

Vitamins are organic compounds required in small amounts to regulate body functions. There are two major categories of vitamins.

Water-soluble vitamins (B-complex, vitamin C) – These vitamins dissolve in water and not stored in the body. They must be consumed daily. These include vitamin B-complex and vitamin C.

Fat-soluble vitamins (A, D, E, K) – These are stored in body fat and used when needed. These include vitamin A, vitamin D, vitamin E, and vitamin K.

A substance in carrots, called carotene, is converted to vitamin A in our body.
In the presence of sunlight, skin converts cholesterol to vitamin D.

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Table: Sources and Roles of Vitamins			
Vitamin		**Sources**	**Role in the Body**
Water-soluble vitamins	**Vitamin B-Complex**	• Whole grains; Meat and poultry; Dairy products; Leafy green vegetables; Nuts and seeds	• Supports energy production and metabolism • Aids brain function and nerves • Helps in red blood cell formation
	Vitamin C (Ascorbic Acid)	• Citrus fruits; Strawberries; Tomatoes; Broccoli	• Strengthens the immune system • Promotes wound healing • Helps for healthy skin, bones, and blood vessels • Acts as an antioxidant
Fat-soluble vitamins	**Vitamin A**	• Carrots; Sweet potatoes; Spinach; Liver; Dairy products	• Essential for good vision and eye health • Supports immune function
	Vitamin D	• Sunlight exposure; Fatty fish (salmon, tuna); Egg yolks; Fortified dairy products	• Helps in calcium absorption for strong bones and teeth • Supports immune system • Maintains muscles and nerves
	Vitamin E	• Nuts and seeds; Spinach; Sunflower oil; Avocados	• Acts as antioxidant, protecting cells from damage • Supports skin health and immunity
	Vitamin K	• Leafy greens (spinach, broccoli); Soybeans; Dairy products	• Essential for blood clotting • Supports bone health

Figure 8.4: Sources of water-soluble vitamins

Figure 8.5: Sources of fat-soluble vitamins

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2. Minerals

Minerals are inorganic elements required for various body functions.

Macro-minerals – Needed in larger amounts (100 mg or more per day). These include Calcium, Magnesium, Potassium, Sodium, and Phosphorus.

Trace Minerals – Needed in smaller amounts (less than 100 mg per day). These include Iron, Zinc, Iodine, Fluoride, and Selenium.

Table: Sources and Roles of Minerals

Mineral	Sources	Role in the Body
Calcium	• Milk and dairy products; Leafy greens (spinach, kale); Almonds; Fish with edible bones (sardines, salmon)	• Builds and maintains strong bones and teeth • Supports muscle and nerve function • Helps in blood clotting
Magnesium	• Nuts (almonds, cashews); Whole grains; Leafy green vegetables; Bananas; Dark chocolate	• Supports muscle and nerve function • Regulates blood sugar levels • Aids in bone formation
Potassium	• Bananas; Potatoes; Oranges; Spinach; Beans; Dairy products	• Maintains fluid balance • Supports muscle contractions • Regulates blood pressure; Helps nerve function
Sodium	• Table salt; Processed foods; Dairy products; Seafood	• Regulates fluid balance • Supports nerve signalling • Maintains blood pressure
Phosphorus	• Meat; Fish; Dairy products; Eggs; Nuts; Whole grains	• Helps form bones and teeth • Assists in energy production • Supports cell repair
Iron	• Red meat; Poultry; Apples; Fish; Spinach; Lentils; Beans; Fortified cereals	• Essential for haemoglobin production • Supports brain function and muscle activity

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Zinc	• Meat; Shellfish; Dairy products; Nuts; Whole grains; Legumes	• Supports immune function • Helps in wound healing • Aids growth and development
Iodine	• Iodized salt; Seafood; Dairy products; Eggs	• Essential for thyroid hormone production • Regulates metabolism, growth, and energy levels
Fluoride	• Fluoridated water; Seafood; Tea	• Strengthens teeth • Supports bone health
Selenium	• Brazil nuts; Seafood; Eggs; Whole grains; Dairy products	• Acts as an antioxidant, protecting cells from damage • Supports thyroid function • Boosts immunity

Water and Dietary Fibres

Water and dietary fibres play important role for our bodies.

Water

Water makes up more than 90 percent of the fluid part of the blood. The reactions of metabolism can only take place in water. Water also participates in many reactions e.g. digestion. It carries materials from one part of the body to other. Water also helps to regulate body temperature.

Dietary Fibre

The indigestible part (cellulose) of plant-based foods is called dietary fibre or roughage. Humans cannot break down dietary fibre because the body lacks the enzyme cellulase. Dietary fibre:

Figure 8.6: Main sources of dietary fibre

- speeds up the passage of food through gut.
- reduces the risk of constipation and cancer of colon.
- absorbs cholesterol and so reduces the blood cholesterol level.

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8.2 INTERNATIONAL DIETARY GUIDELINES

The Food and Agriculture Organization (FAO) of the United Nations and the World Health Organization (WHO) have developed dietary guidelines to foster healthy eating habits and lifestyles among the general public. Their guidelines contain advice on foods, food groups and dietary patterns.

Food Pyramid Published by WHO and FAO

The dietary guidelines published by the WHO and FAO can be represented in a food pyramid. The food pyramid is a diagram that shows the optimal number of servings to be eaten each day from each food group. Its main objective is to prevent obesity, improper nutrition, and chronic diseases. The food pyramid is based on the following recommendations:

Diets	Recommendations of WHO and FAO
Total carbohydrate	55–75%
Total fat	15–30%
Protein	10–15%
Free sugars	$<10\%$
Cholesterol	< 300 mg/day
Sodium chloride (Sodium)	< 5 g/day
Fruits and vegetables	≥ 400 g/day

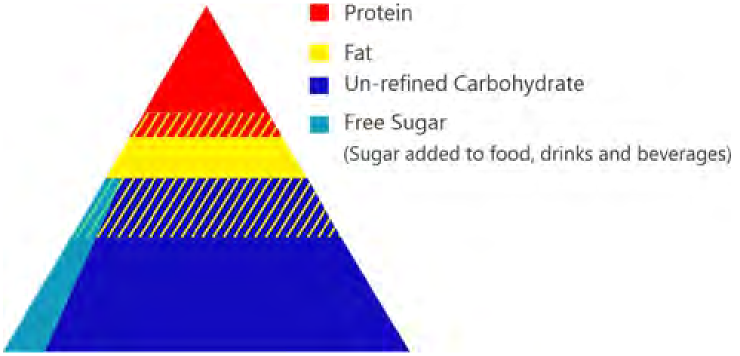

Figure 8.7: Food Pyramid advised by FAO and WHO

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8.3 PAKISTAN DIETARY GUIDELINES

The Government of Pakistan developed "Pakistan Dietary Guidelines for Better Nutrition". The guidelines provide a list of foods with number of servings to help the general public for a healthy, long and active life.

My Plate

The Pakistan Dietary Guidelines for Better Nutrition contains the concept of "My plate". It represents the food groups that must be present in diet to fulfil the nutritional requirements of the body. The following are the basic groups mentioned in "My Plate":

(i) **Cereal grains and grain products –** This group provides carbohydrates, protein, vitamins (thiamine), vitamin E and minerals. It provides over 50% of energy, protein, vitamins and mineral requirements of the body.

(ii) **Meat, pulses and eggs –** This group is a rich sources of proteins and minerals.

Figure 8.8: My Plate

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(I) Milk and milk products – It is a rich source of calcium, phosphorous, protein, lactose, minerals and vitamins.

(ii) Vegetables – This group is essential for providing antioxidants, dietary fibre, vitamins and minerals. More consumption of vegetables is recommended to meet the nutritional requirements, maintain desirable body weight, and prevent the incidence of chronic diseases.

(iii) Fruits – This group is essential for providing vitamins and minerals. It also provides phytochemicals and dietary fibre for optimal metabolic functions, growth and development.

(iv) Oil and Fat – This group is included in my plate because fats and oils are components of traditional Pakistani diet. Fat, oil, salt and sugar should be used moderately.

Serving size and Frequency of Servings

The dietary guidelines recommend serving sizes to these age groups: Infants (0-6 months); Infant and young children (6-24 months); Children (2-3 years); Children (3-10 years); Adolescents (10-19 years); Adults (19-60 years); Elderly (>60 years); Pregnant women; Lactating mothers.

Table: Food and No. of Servings for Different Age Groups

Food Group	No. of Servings /Day				
	Children (2-3 yrs)	Children (3-10 yrs)	Adolescents (10-19 yrs)	Adults (19-60 yrs)	Elderly (>60 yrs)
Milk & milk products	2	2-3	3-4	2-3	2-3
Cereal grains & grain products	1-2	3-5	5-6	4-5	4-5
Vegetables	1-2	1-2	2-3	2-3	2-3
Fruits	1-2	1-2	2-3	2-3	2-3
Meat, pulses & eggs	1-2	3-4	2-3	2-3	2-3
Others	• Use a minimum amount of salt and sugars and oil. • Avoid junk and refined foods, sweets, soft drinks, French fries, samosa, and other deep-fried foods.				

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Serving Size and Description

Food Group	Serving size and description
Milk and milk products	1 serving = 1 cup of milk or 1 cup of yogurt or 1 slice of cheese or 1 cup of kheer or feerni or other milk-based products.
Cereal grains and grain products	1 serving = 1 chapatti or 2 slices of bread (toast) or 2/3 cup of cooked rice or 1 cup of cereals.
Vegetables	1 serving = 1/2 cup of cooked non-starchy vegetables or 1/2 cup of vegetables juice/soup or 1 cup of fresh vegetables/salad.
Fruits	1 serving = 1 small size banana or 1 apple or 1 peach or 2-3 plums or 3-4 apricots
Meat, pulses and eggs	1 serving of meat (28 g lean meat = 1-2 small pieces of meat or 1-2 pieces of fish or 1 egg, or ½ cup of cooked pulses).

Table: Food and No. of Servings for Pregnant and Lactating Women

Food Group	No. of Servings /Day	
	Pregnant Women	Lactating Women
Milk & milk products	2-3	3-4
Cereal grains & grain products	5-6	5-6
Vegetables	2-3	2-3
Fruits	2-3	2-3
Meat, pulses & eggs	2-3	2-3

Activity

- Design a balanced meal plan for a day based on dietary guidelines.

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Healthy Snacks

Pakistan Dietary Guidelines recommend the following as healthy snacks.

- All seasonal fruits
- Milk and milk products (lassi, yogurt, cheese, milk shake with fruits like banana, mango, strawberry, apple) with minimum or no added sugar
- Fresh salad and green, yellow and red vegetables
- Roasted pulses and beans
- Potato cutlets
- Shami kabab
- Shami sandwich with fresh salad
- Chicken sandwich with salad
- Potato cutlet sandwich with salad
- Cheese sandwich with salad
- Egg sandwich with fresh salad
- Fruit chat, Chana chat
- Dahi barray
- Nuts and dried fruits

Seasonal fruits | Fruit chat | Chana chat
Potato cutlets | Nuts & dried fruits | Shami sandwich
Lassi | Milkshake | Fresh salad

8.4 DIET-RELATED CHRONIC DISEASES

Diet is one of the strongest predictors of health and disease. Unhealthy dietary habits and physical inactivity are the major factors of overweight, obesity and chronic diseases e.g., diabetes, heart disease, hypertension, and even certain cancers. Many of these conditions arise due to consumption of unhealthy foods and insufficient intake of essential nutrients.

> In Pakistan, the diet of both poor and higher income households is comprised of energy-dense foods with little diversity. Therefore, micronutrient deficiencies are common in the population.

Harmful Dietary Habits and Their Effects

1. Consumption of Processed and Fast Foods

Regular consumption of processed and fast foods increases the risk of obesity, cardiovascular diseases, and high blood pressure.

Figure 8.9: Alternate to processed & fast-food

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2. Excess Sugar Consumption

Sugary foods and beverages (such as soft drinks, candies, and pastries) contribute to diabetes, weight gain, and dental problems.

3. Taking Less Dietary Fibre

A diet low in fibre (due to less consumption of fruits, vegetables, and whole grains) can cause constipation and digestive issues.

4. Consuming High Amounts of Salt

Consuming too much salt (found in processed foods and snacks) leads to high blood pressure, which is a major risk factor for stroke and heart disease.

5. Consuming Excess Saturated and Trans Fats

Foods high in saturated and trans fats (like fried foods, margarine, and processed meats) raise bad cholesterol i.e., Low Density Lipoproteins (LDL) levels. It increases the risk of atherosclerosis, heart attacks, and strokes.

6. Low Intake of Essential Nutrients

Diets lacking essential vitamins and minerals (such as calcium, iron, and vitamin D) can cause osteoporosis, anaemia, and weakened immunity.

7. Overeating and Irregular Meal Patterns

Eating excessively, skipping meals, or eating late at night can disrupt metabolism, leading to weight gain and digestive disorders.

8.5 MALNUTRITION

Malnutrition means taking a diet in which the required nutrients are not enough or are too much. If the diet is short of nutrients, it is called undernutrition and if diet has too much nutrients, it is called overnutrition.

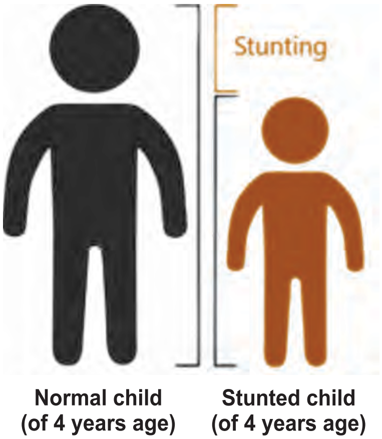

Figure 8.10: Stunting

Undernutrition

Undernutrition is a condition that occurs when the body does not receive enough nutrients to meet its daily energy and growth requirements. The following are the major health problems in Pakistan due to undernutrition.

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1. Stunting (Chronic Malnutrition)

Stunting is a condition where a child is shorter than expected for their age. It is due to long-term nutritional deficiency. It is measured by a child's height-for-age.

Causes:

- Inadequate nutrition during pregnancy and early childhood
- Poor maternal health and repeated infections
- Deficiency of vitamins and minerals (especially protein, iron, and zinc)

Symptoms:

- Shorter-than-average height, delayed physical and mental development, and weak immune system

Consequences:

- Reduced brain development and increased risk of chronic diseases

Prevention:

- Proper maternal nutrition during pregnancy
- Providing balanced diets
- Promoting exclusive breastfeeding for the first six months of life
- Improving sanitation and healthcare

> Pakistan has the largest population of stunted children in South Asia. According to UNICEF, more than 40% of children under five years age in Pakistan are stunted. In Punjab, 31.5% of children (under five years of age) are stunted.

2. Wasting (Acute Malnutrition)

Wasting is defined as low weight for height. It indicates severe weight loss due to lack of food or due to disease. It is a sign of acute undernutrition, often resulting from famine, illness, or poor dietary intake.

Causes:

- Severe food shortages and poor diet
- Recurrent infections (diarrhoea and pneumonia)

Figure 8.11: Wasting

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Symptoms:

- Rapid weight loss and muscle wasting. weakness, fatigue, increased risk of infections and delayed recovery from illness

Consequences:

- High risk of death if untreated and weakened immune system

Prevention:

- Proper feeding practices for infants and young children
- Ensuring access to high-energy, nutrient-dense foods

According to UNICEF, 17.7% of children under five years of age are wasted in Pakistan. In Punjab, this ratio is 7.3%.

3. Anaemia (Iron Deficiency)

Anaemia is a condition where the body lacks enough healthy red blood cells to carry oxygen. It is usually due to iron deficiency. It affects people of all ages but is particularly common among women, children, and individuals with poor diets.

According to UNICEF, 53% of children under five years of age in Pakistan suffer from anaemia. 42% of women in reproductive age are also anaemic. In Punjab, this ratio is almost the same.

Causes:

- Low intake of iron-rich foods
- Blood loss due to menstruation, injury, or childbirth
- Intestinal infections affecting nutrient absorption

Symptoms:

- Fatigue and weakness, pale skin, shortness of breath, dizziness and headaches, poor concentration and reduced work performance

Consequences:

- Reduced physical and mental performance and delayed growth

Prevention:

- Consuming iron-rich foods
- Taking iron supplements, especially for pregnant women
- Improving access to clean water and sanitation
- More vitamin C intake (from citrus fruits) to enhance iron absorption

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Overnutrition

It is a form of malnutrition that occurs when the body receives excessive nutrients. Overnutrition can lead to conditions such as obesity and associate problems such as diabetes and cardiovascular diseases.

Obesity

Obesity is a condition where excessive fat accumulates in the body. It is a growing global health concern, affecting both children and adults.

Obesity is measured using the Body Mass Index (BMI). For calculating the BMI, body mass (weight) is divided by the square of body height. It is expressed in units of kg/m^2.
A body mass index (BMI) over 25 kg/m^2 is considered overweight. A BMI over 30 kg/m^2 is obese.

According to the WHO, 43.9% of Pakistanis are obese, and 58.1% are overweight.

Causes:

- Consumption of unhealthy diet such as processed foods, sugary drinks, and fast-food.
- Excessive screen time and reduced physical movements.
- Genetic factors: Some individuals may have obesity due to inheritance.
- Hormonal imbalance such as insulin resistance.
- Psychological Factors such as stress and depression.

BMI < 18.5 BMI 19-24.9 BMI 25-29.9 BMI 30-34.9 BMI < 35

Figure 8.12: BMI values and obesity

Symptoms:

- Excess body fat, particularly around the abdomen, thighs, and arms.

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- Breathlessness and fatigue, even after mild physical activity.
- Joint and back pain due to increased pressure on bones and muscles.
- Frequent sweating and difficulty in regulating body temperature.

Consequences:

- Cardiovascular diseases, diabetes, respiratory problems, joint and bone disorders, mental health issues, and increased risk of certain cancers.

Prevention of Obesity:

- **Balanced Diet:** Eating a variety of nutrient-dense foods, while avoiding processed and high-fat foods.
- **Regular Exercise:** Engaging in at least 30–60 minutes of physical activity daily, such as walking, cycling, or swimming.
- **Reducing Sugar and Fat Intake:** Taking less sugary drinks, fried foods, and excessive fast-food consumption.
- **Staying Hydrated:** Drinking enough water helps control appetite.
- **Adequate Sleep:** Getting 7–9 hours of sleep per night, as poor sleep can increase hunger hormones.
- **Stress Management:** Practicing meditation, yoga, or deep breathing to reduce emotional eating.

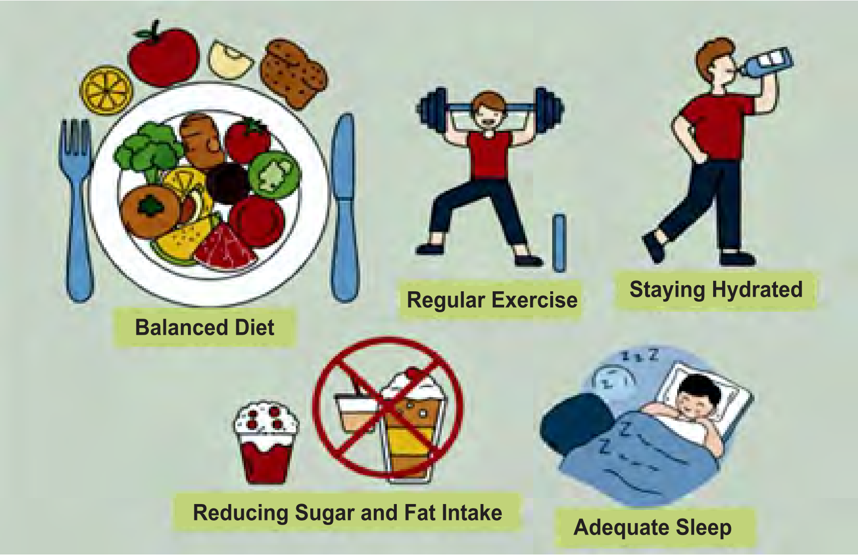

Figure 8.13: Keys preventions of obesity

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8.6 IRON AND VITAMIN DEFICIENCIES

Deficiencies of vital nutrients like iron and vitamins in the diet can lead to serious health issues. Iron and vitamin deficiencies are widespread in many developing countries, including Pakistan. These deficiencies cause a range of symptoms affecting growth, immunity, and overall well-being.

Iron Deficiency

Iron deficiency occurs when the body does not have enough iron. Iron is an essential mineral required for producing haemoglobin. Its deficiency leads to Iron Deficiency Anaemia (IDA).

Symptoms:

- Fatigue and weakness, pale skin and brittle nails, shortness of breath, dizziness and headaches, cold hands and feet, poor concentration and memory issues.

Causes:

- Taking diet low in iron-rich foods
- Blood loss due to injury or childbirth

Prevention:

- Taking iron-rich diet like red meat, chicken, fish, lentils, spinach, and fortified cereals
- Taking vitamin C to increase iron absorption
- Taking less tea and coffee - these contain tannins, which inhibit iron absorption
- Taking iron supplements

Vitamin Deficiencies

Vitamins are essential nutrients that help the body perform various functions. Deficiencies in vitamins can lead to serious health problems. The most common vitamin deficiencies include Vitamin A, Vitamin D, and B-Complex deficiencies.

Vitamin A Deficiency

Vitamin A is crucial for vision, immune function, and healthy skin. A deficiency can cause severe health issues, especially in children.

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Symptoms:

- Night blindness and dry eyes, weak immunity, dry & scaly skin and slow wound healing

Causes:

- Low intake of vitamin A-rich foods
- Poor absorption due to digestive disorders.

Prevention:

- Eating foods rich in vitamin A, such as carrots, spinach, dairy, and fish.
- Vitamin A supplements for at-risk populations.

Vitamin D Deficiency

Vitamin D helps the body absorb calcium, which is essential for strong bones and teeth. Its deficiency leads to bone disorders.

Symptoms:

- Weak bones and muscle pain, and increased risk of fractures

Causes:

- Lack of sun exposure
- Insufficient intake of vitamin D-rich foods like fish, eggs, and fortified dairy.

Prevention:

- Spending time in sunlight.
- Consuming vitamin D-rich foods and supplements.

Vitamin B-Complex Deficiency

Vitamin B-Complex includes several B vitamins essential for energy production, nervous system function, and red blood cell formation. Deficiencies can cause various health issues.

Symptoms:

- Fatigue and weakness, numbness and tingling in hands and feet, mouth ulcers and skin problems, and memory issues and confusion.

Causes:

- Poor diet lacking in whole grains, meat, dairy, and eggs.

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- Alcohol abuse, which interferes with vitamin B absorption.

Prevention:

- Eating vitamin B-rich foods such as whole grains, meat, fish, and eggs.
- Taking vitamin B supplements if necessary.

EXERCISE

A. Select the correct answers for the following questions.

1. Why are fats essential despite being high in calories?
   a) Store vitamins and energy
   b) Main energy source
   c) Aid protein digestion
   d) Regulate water balance
2. Why are proteins important?
   a) Main energy source
   b) Build and repair tissues
   c) Store energy
   d) Needed only for muscles
3. Pale skin and fatigue suggest a deficiency of?
   a) Vitamin A
   b) Calcium
   c) Iron
   d) Protein
4. Which food group helps in muscle growth and repair?
   a) Vegetables
   b) Fruits
   c) Meat, pulses, and eggs
   d) Oil and fat
5. Why should oil and fats be consumed in moderation?
   a) They contain no nutrients
   b) They can cause muscle loss
   c) Excess intake leads to obesity and heart diseases
   d) They reduce calcium absorption
6. Which dietary habit increases the risk of diabetes?
   a) Eating a balanced diet
   b) Drinking plenty of water
   c) Consuming too much sugar and refined carbohydrates
   d) Eating high-fibre foods

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7. What is the main cause of stunting in children?
   a) Lack of sleep
   b) Chronic malnutrition
   c) Excessive sugar intake
   d) Too much physical activity
8. Why is anaemia more common in young children and women?
   a) Due to high iron requirements and low intake
   b) Due to excessive protein consumption
   c) Because they eat too many carbohydrates
   d) Because they drink too much water
9. Which of the following is a key sign of wasting?
   a) Excess fat accumulation
   b) Severe weight loss and muscle thinning
   c) High blood pressure
   d) Increased appetite
10. What is a major health risk associated with obesity?
   a) Improved digestion
   b) Stronger immune system
   c) Increased risk of heart disease and diabetes
   d) Higher bone density

B. Write short answers.

1. Differentiate between macronutrients and micronutrients with examples.
2. What is the role of proteins in the body?
3. Why are vitamins and minerals essential for maintaining good health?
4. Define balanced diet. What are the main groups of food in a balanced diet?
5. Differentiate between wasting and stunting.

C. Write answers in detail.

1. Describe the role of carbohydrates, proteins, and fats in the body. Also write their sources.
2. Explain the importance of a balanced diet and how dietary guidelines help in preventing malnutrition and chronic diseases.

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3. Define malnutrition and differentiate between undernutrition and overnutrition. Provide examples and their consequences.
4. Write notes on stunting, wasting, and obesity. Explain their causes, symptoms, consequences, and preventive measures.
5. What is anaemia? Explain its causes, symptoms, effects on the body, and how it can be prevented.

Group Activities

1. Design a balanced meal plan for a day based on dietary guidelines.
2. Create a chart listing examples of macronutrients and micronutrients and their food sources.
3. Write a short essay on the importance of following dietary guidelines.
4. Create a poster highlighting the effects of malnutrition on health.
5. Write a report on the prevention and management of iron deficiency anaemia.
6. Create a presentation on the role of nutrition in preventing Type 2 Diabetes.

Practical Activities

1. Analyse food samples to detect the presence of macronutrients (starch, proteins, and fats) using standard biochemical tests.
2. Determine the pH levels of different digestive juices and explain their role in digestion.

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